REFERENCE-BOOK OF PRACTICAL THERAPEUTICS

BY VARIOUS AUTHORS

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IN TWO VOLUMES

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PREFACE.

THE leading idea in the preparation of this work has been to make it pre-eminently serviceable to the practising physician. It is not intended to take the place of treatises on materia medica or on pharmacy; hence, as regards the physical properties of drugs, their mineralogical, chemical, botanical, or zoological relations, etc., the endeavour has been to set down only so much as is of direct bearing on the use of those drugs in medical practice or on the management of poisoning due to them. Even accounts of the physiological actions of drugs are condensed, for much of what the experimental pharmacologist justly looks upon as essential to the prosecution of his studies is useless and clogging superfluity to the physician in his daily work of treating the sick. For the same reason, profusion of references to literature has been avoided, although at the same time it is believed that due credit has been given as to sources of information.

The "therapeutic nihilism" that but a few years ago was justly deplored by Professor Bartholow has been succeeded by a wave of over-activity for which it is not difficult to account. We have now to master the task of judiciously employing remedial agencies many of which are new; for this purpose we require the frequent appearance of trustworthy records of what has been accomplished with these novel agents, for in no other way can the individual practitioner keep pace with the progress of therapeutics. He who presents to the medical profession books purporting, as this one does, to contain only such positive statements about remedial agents as rest upon what seems to be a substantial basis—he who does that undertakes a work of no little responsibility. In the present instance the editor has been favoured with the collaboration of a number of writers whose teachings are known and respected. As this first volume goes to the press, it is with sorrow that he has to speak of the untimely death of two of them, the late Dr. Edward R. Palmer, of Louisville, and the late Dr. Benjamin F. Westbrook, of Brooklyn, both of whom had done important work on the book.

In such a book as this, written by various authors, there is necessarily some overlapping in the treatment of certain topics; that is to say, one author treats of a certain drug, but another, writing on a different theme, finds occasion to mention the drug assigned to the first one as a subject. If this resulted only in repetition, it might be considered a defect. But that is not the case; two or more writers on such a subject as therapeutics are not likely to inculcate exactly the same thing, except as to mere commonplaces. Indeed, the exposition of a topic by more than one author is recognised as one of the best ways for getting at the truth; the subject is treated of from more than one point of view, and additional light is thrown upon it.

There are many drugs that it has not seemed necessary to mention in this

book—some, because they have fallen into almost absolute disuse and are now of historical interest only; others, because they are used only in far distant countries, often by peoples not more than semi-civilized, and are rarely if ever met with in the markets of Europe and North America; still others, because they have been so recently brought forward that too little is known of them to warrant a writer in making definite statements concerning them. There is another class that may be called catchpenny products, put upon the market by persons of business enterprise without an excess of scrupulousness and wafted into a certain vogue—temporary and inglorious—by men who, while professing to write for the advancement of medicine, are really in the proprietors' pay, directly or indirectly. This class is to be carefully distinguished from those proprietary preparations that are really valuable, that are produced by careful and honourable makers, and that are in actual use by practitioners of high attainments and known probity. Many of these preparations are used almost daily by every practising physician, and there is hardly an issue of any of the most reputable medical journals in which more or less space is not devoted to them. They can not be ignored and they ought not to be. But there is a sort of neutral ground, so to speak, between these established proprietary preparations and those worthless and perhaps fraudulent productions to which allusion has been made. This neutral ground is occupied by products that have been but a short time in the market, and have not been subjected to sufficient investigation by competent persons to render it safe to make statements of any practical value with regard to them. Often it is impossible at first to tell whether they are in the hands of designing and untrustworthy men or whether their introduction proceeds from individuals of laudable intentions and possessed of the knowledge necessary to enable them to test new drugs adequately. It is an almost weekly occurrence for a new coal-tar derivative, for example, or an old compound under a new name, to be brought out as a remedy that, in the hands of some physician in a distant country, has, according to the early published accounts that reach us, produced wonderful results in the cure or mitigation of some disease; and these accounts almost always include an assurance that the drug is "non-poisonous." In short, the literature of that drug is in the florid stage; it may take its place in the recognised materia medica; it may, "non-poisonous" as it has been proclaimed to be, shortly prove fatal when used in doses well within those employed by its introducer, and come to be looked upon as too dangerous to be adopted; or it may simply fall into disuse because further trial of it does not reveal to others the virtues ascribed to it by him who first brought it into notice. In this work the endeavour has been made to keep these considerations constantly in mind, and not to be hasty in promulgating statements that, although they appear well founded, may turn out to be erroneous.

The editor's main work in the preparation of this book, besides that of planning it and selecting the authors, has been to furnish the minor articles, together with some paragraphs or sections, distinguished by being inclosed in brackets, interpolated into the signed articles. These additional passages include summaries of observations that have appeared since the original articles were written. In his part of the work the editor has resorted freely to current literature, and he wishes to mention in particular the aid he has derived from the *United States Dispensatory*, from the *National Dispensatory*, from Eulenburg's *Real-Encyclo-*

pädie der gesammten Heilkunde and his *Encyclopädische Jahrbücher der gesammten Heilkunde*, from Geissler and Möller's *Real-Encyclopädie der gesammten Pharmacie*, from the Squibbs' *Ephemeris of Materia Medica*, etc., from Cerna's *Notes on the Newer Remedies*, from Bocquillon-Limousin's *Formulaire des médicaments nouveaux*, from Soulier's *Memento formulaire des médicaments nouveaux*, and from Husemann's *Handbuch der Arzuneimittellehre*.

Great care has been taken to make the Index of Diseases, etc., full and specific; and, notwithstanding the alphabetical arrangement of headings in the body of the work, it has been thought best to add an index of remedies, for the reason that drugs are often mentioned under other headings than their own names.

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HANDBOOK OF THERAPEUTICS.

A. B. C. BALSAM.—Unguentum elemi.

A. B. C. OINTMENT or **SALVE.**—The unguentum flavum of the Ger. Ph., 1st ed.

ABELMOSCHUS.—A genus of malvaceous plants. *Abelmoschus* (or *Hibiscus*) *esculentus* furnishes okra pods, and demulcent poultices are made from the root. A paste and a syrup made from the seeds (which are distinguished from those of *Abelmoschus moschatus*, musk seeds, by being odourless and unstriped) are used like similar preparations of marsh mallow.

ABIES.—A genus of the *Coniferæ* (suborder *Abietineæ*) including the fir trees. *Abies balsamea* furnishes Canada balsam. *Abies communis* (or *excelsa*), the Norway spruce, yields Burgundy pitch. *Abies pectinata* (or *picea*), the European silver fir, furnishes Strassburg turpentine.

ABLUENTS.—See DETERGENTS.

ABORTIFACIENTS, ABORTIVES.—Certain drugs (chiefly ergot, tansy, and savin) are reputed to have the property of causing abortion. Their use for such a purpose has no place in medicine.

ABRUS PRECATORIUS.—See JEQUIRITY.

ABSINTHIUM [U. S.].—*Herba absinthii*, *grande absinthe*, *aluyne* (Fr. Cod.); the leaves and tops of *Artemisia Absinthium*, wormwood; a stomachic tonic, formerly used as an anthelminthic, now little used for any purpose. An infusion of an ounce in a pint of water may be drank freely. A volatile oil distilled from the drug (*oleum absinthii* [Ger. Ph.], *huile volatile d'absinthe* [Fr. Cod.]) has been used internally as an antispasmodic, in doses of a drop or two, and locally as an analgetic. In large doses the oil produces epileptoid convulsions, coma, and death.

ABSORBENTS are drugs which act by absorbing (sometimes by neutralizing) deleterious gases or liquids, also those which promote the absorption of exudates, etc. Cf. ANTACIDS and SORBEFACIENTS.

ABSTERGENTS, ABSTERSIVES.—See DETERGENTS.

ACACIA [U. S.].—Gum arabic; the *acaciæ gummi* of the Br. and Austr. Ph's; the *gummi arabicum* of the Ger. Ph.; the *gomme arabique* of the Fr. Cod.; a clear, whitish gum that exudes from various species of trees of the genus *Acacia* (of the *Leguminosæ*, suborder *Mimoseæ*), especially *Acacia Senegal.* Gum arabic dissolves readily in cold water, and, so dissolved, is used as a demulcent. It has been considered somewhat nutritive. The *mucilago acaciæ* of the U. S. Ph. is a solution of 340 parts of gum arabic in enough water to make 1,000 parts by weight; this, mixed with three times its bulk of syrup, constitutes the *syrupus acaciæ* of the U. S. Ph. The *mucilago acaciæ* of the Br. Ph. is a solution of 2 parts of gum arabic in 3 of distilled water.

A. C. E. MIXTURE.—A mixture of alcohol, chloroform, and ether; so called from the initial letters of the names of its ingredients. In the United States, where such a mixture is much used as an anæsthetic, the proportions are generally 1 part of alcohol, 2 parts of chloroform, and 3 parts of ether, by bulk. It is esteemed safer than chloroform alone and more agreeable and speedy in its action than ether alone. The alcohol is added with the view of promoting the intimate blending of the chloroform and ether.

ACETAL.—The acetals are formed by the action of an alcohol on a nascent aldehyde. Ordinary acetal, *diethylacetal*, $CH_3CH(C_2H_5O)_2$, is a thin, colourless, volatile liquid, of agreeable odour and taste, which contributes prominently to the flavour and bouquet of old wines. It dissolves readily in all proportions in alcohol and in ether, and in eighteen times its volume of water. By oxidation, to which it is prone when exposed to the air, it is transformed into aldehyde, and then into acetic acid. Acetal is a hypnotic closely resembling chloral in its action, but much less powerful, regarded as especially suitable in cases of mental or emotional disturbance. The dose is from a drachm to a drachm and a half, in water or wine.

Dimethylacetal, $CH_3CH(CH_3O)_2$, has the same medicinal properties, but is still feebler, so that the dose is twice as large as that of ordinary acetal. A mixture of two volumes of dimethylacetal with one volume of diethylacetal has been recommended as an anæsthetic less apt to enfeeble the heart than chloroform. Acetal may be detected in the breath for several hours after its administration.

ACETALDEHYDE.—See ALDEHYDE.

ACETANILIDE, phenylacetamide, C_6H_5. $NH.C_2H_3O$, the *acetanilidum* of the pharmacopœias, is known also under the proprietary name "antifebrine." It is an acetal derivative of aniline, and appears as white, shining, micaceous, crystalline laminæ, or a crystalline powder, odourless, having a faintly burning taste, and permanent in the air. Should acetanilide give a reddish-orange precipitate with sodium hypobromite, it contains aniline and should be rejected.

Given to a healthy adult, in a dose of from 5 to 10 grains, it produces usually no effect. A repetition of the dose commonly results in somnolence, and at times malaise, a weakening of cardiac force, and slight cyanosis, especially of the face and extremities. In the absence of fever no fall of temperature results.

Given in the presence of *pyrexia* and in therapeutic doses there usually occurs a marked fall of temperature, which usually begins within one or two hours, soon reaches its maximum, and lasts even to eight or ten hours. Coincident with the fall in temperature is a reduction of the pulse rate and force, with a disappearance of other febrile symptoms. Sweating frequently accompanies the fall in temperature, but is apt to be less than that caused by antipyrine. That the fall in temperature is not dependent upon the sweating is proved by the fact that the antipyretic effect of the drug is no less marked even in the absence of sweating. This action of acetanilide in causing reduction of temperature is not thoroughly understood, but it is believed to act mainly by diminishing heat production, and also, though to a lesser degree, by increasing heat dissipation. Though a fall of temperature follows the administration of a therapeutic dose of the drug in the vast majority of cases, the rule is not invariable, and an occasional failure of any antipyretic effect marks the capricious nature of acetanilide.

While the antipyretic dose of acetanilide is usually about 4 grains, much larger doses have been given with no ill effect, even to 100 grains in twenty-four hours; moreover, a single dose of 1 drachm has been well borne by a healthy subject. Ill effects often follow the larger doses, however, and 10 grains is scarcely a safe dose for routine administration; indeed, serious symptoms are sometimes seen after an ordinary therapeutic dose, though in this respect the unreliability of acetanilide does not approach that of antipyrine. Of adverse symptoms following the administration of acetanilide, the most common is a slight cyanosis which in itself is seldom of gravity. Weakening of the cardiac force and of the radial pulse is, however, a more serious occurrence which not very uncommonly appears to some extent. The appearance of an eruption from the giving of acetanilide is exceedingly rare, though not unknown; vomiting, too, may occur, but is comparatively rare. In a few cases collapse has been seen coincident with the fall in temperature, but it is by no means so common as after the administration of antipyrine. Since acetanilide is practically insoluble in water, it should be given in alcoholic solution or, better still, in powder, capsule, or tablet. Its therapeutic dose is from 2 to 8 grains.

Poisoning by acetanilide is marked by prostration, cyanosis, sweating, cold extremities, shallow and feeble respiration, dilated pupils, and weak heart action, which may be rapid, slow, or irregular. Death takes place in fatal cases from cardiac paralysis. Unconsciousness may occur, but in many cases it is absent almost to the time of death. The depression of the circulation following the administration of acetanilide is far more likely to occur if the patient remains in the erect attitude. It is far wiser, therefore, for him to lie down. The treatment in cases of poisoning is by active stimulation with the application of heat externally and the inhalation of oxygen.

As a result of the continued administration of acetanilide, there may occur in man anæmia, with congestion of the liver, kidneys, and spleen. That such congestions will result in degeneration is probable, and experiments on animals show that the continued use of acetanilide in large doses is the direct cause of fatty degeneration of the heart, liver, and kidneys.

The therapeutic value of acetanilide depends upon its properties of reducing febrile temperature, preventing spasm, and relieving pain; and though for some time after its introduction its antipyretic action was prominently considered to the underrating and almost to the ignoring of its other powers, more extended use of the drug and more deliberate consideration have resulted in making known its other properties, which are in reality the more valuable.

The impression, unfortunately deep-rooted, that *fever* is an enemy to be met and vigorously attacked whensoever and wheresoever it makes its appearance, has been the cause of innumerable therapeutic blunders and of incalculable harm. Unfortunate indeed was this belief previous to the introduction of the modern antipyretic drugs, but with their appearance the situation became doubly serious, for there were then put into the hands of the prejudiced and the indiscreet the weapons wherewith the supposed enemy might be attacked, but weapons which, unwisely used, became the most dangerous of instruments. In their eagerness to drive away the fever many were quite regardless of the fact that a moderate rise of temperature lasting for a limited time was in itself comparatively harmless, and therefore they hastened to remove this elevation of temperature by the administration of drugs which in themselves were not harmless, and thereby they substituted a frequently positive harm for an often unimportant symptom. Among the drugs so misused was acetanilide, and, though probably the cause of less mischief than antipyrine, primarily because it is a less dangerous drug, but mainly because the previous appearance of antipyrine had been productive of the wisdom learned by experience, yet its indiscriminate use resulted not seldom in repeated sweating and consequent exhaustion, cyanosis, enfeebled circulation, and, in some cases, collapse and death.

The correction of these errors is due to three things: First, the introduction of hydrotherapy

into general use as a means of treating fever and its symptoms, whereby a relatively harmless procedure was substituted for dangerous drugs; second, a realization of the dangerous properties possessed by the so-called antipyretic drugs; and third, and more important than all, the appreciation that fever in itself is not necessarily a dangerous symptom unless excessive, and therefore does not call for removal unless it is an evident cause of harm.

In *typhoid fever* acetanilide has been and still is much used, but its employment in this disease, except for the purpose of reducing temperature unusually and temporarily high, is not to be recommended, for the very nature of the disease, which is prolonged, exhausting, and generally adynamic, should prohibit the use of a drug which in continued employment constantly tends to the depression of the vital forces without possessing any compensating good effect on the disease process. Moreover, we have in our possession in hydrotherapy a means of treating the asthenic fevers which, so far from depressing and exhausting, is a stimulant and a tonic.

In *pulmonary phthisis* acetanilide has been much employed to prevent the afternoon rise of temperature. For this purpose it has usually been given in doses of from 2 to 4 grains, late each afternoon. That it does often prevent the occurrence of this rise of temperature is undoubtedly true, and by many this application of the drug is considered of great value; but the sweating so often resulting from the use of the drug is too great a price to pay for the slight benefit obtained in a disease where sweating and the exhaustion resulting from it are usually present and are among the worst of symptoms. Moreover, the tendency the drug has to cause cyanosis is especially prominent in phthisis. The objections to its use in typhoid fever apply with even more force to its use in phthisis, both from the longer course of the disease and from its even more asthenic character.

In *epidemic influenza*, on the other hand, its use is often of great value, less, however, on account of its antipyretic effect than on account of its power to relieve the neuralgic pains which so often accompany *grippe*.

The use of acetanilide as an antipyretic, then, should be confined to those fevers of a dynamic type in which the patient is otherwise strong, in which circulatory disease is absent, in which the temperature is high and from that height itself is obviously doing the patient harm, and in which the duration of the disease is a limited one. In such cases and when a prompt reduction of temperature is of immediate importance, the occasional administration of acetanilide in doses of from 2 to 4 grains is often of great service. Its use in all adynamic conditions is, on the other hand, directly contra-indicated, as tending to depress and to lower the strength and resisting power of the patient and potently to contribute to his exhaustion.

By far the most valuable application of acetanilide is in the *relief of pain*. Thus, in all febrile diseases associated with headache and body pains, as especially noted in epidemic influenza, and where no contra-indication exists, its use is of great service.

In ordinary *headache*, from whatever cause, it will generally relieve the pain, though, unless the headache is of purely nervous origin, its action is seldom curative.

In *migraine* it is frequently of service, and though many authorities hold it less valuable than antipyrine in the treatment of this condition, yet the far greater safety of its employment, together with its general efficiency, renders its use to be highly recommended.

In *neuritis* it is one of the most valuable drugs we possess, and by many is regarded as almost a specific, so constant and so valuable is its action. This action is especially apparent in the treatment of *sciatica*, which modern investigation has placed in the class of neuritis rather than in that of true neuralgia. Though its action in this obstinate affection can not be considered as constant, yet it frequently is of the greatest service, both relieving and curing cases in which many other remedies have failed.

In *optic neuritis* with pain it is said not only to relieve the pain, but to be the direct cause of lessening the inflammation which causes it.

In *neuralgia* it probably has its most valuable application, and though its employment here is to be regarded as symptomatic, so that other treatment appropriate to the cause of the pain must also be employed, yet its power to relieve is so marked and its action so prompt as to render it of the greatest usefulness. Though its use in neuralgia is in most cases merely symptomatic, yet this can not be said of all, for in some cases its action would seem to be directly curative, and especially in those due apparently to exposure to cold and to wet.

In *facial neuralgia* particularly is its action seen at its best. In ordinary cases of neuralgia its dose should be from 3 to 5 grains three times a day.

In *myalgia*, too, acetanilide is of great service, ranking with phenacetine and gelsemium, and, from its greater safety, above antipyrine. Its action in such cases is usually prompt, both in relieving the pain and later in curing the disease. The appropriate dose for such cases is from 3 to 5 grains three times a day.

In *herpes zoster* it promptly relieves the neuralgic pain associated with the condition, but upon the cutaneous eruption it exerts no influence. Its dose in such cases is the same as that employed for ordinary neuralgia.

Gastralgia is at times benefited by the administration of acetanilide, but in such cases its action to relieve is not to be depended upon, and it does not exert any curative power upon the conditions causing the pain.

The condition in which the action of acetanilide is perhaps as valuable and as indispensable as in any other is seen in the *lightning pains associated with locomotor ataxia*. In relieving the suffering caused by these pains acetanilide is probably more reliable, safer, and more thoroughly efficient than any other drug we possess. In the *crises of tabes*, too, its action is often most beneficial, and the relief it affords most marked.

In some cases of *rheumatism*, and especially in those in which pain is a marked feature, acetanilide acts not only to relieve the suffering, but even to cure the disease. Indeed, at times it succeeds in curing cases of rheumatism in which the salicylates have failed to be of use, and though in no way a substitute for the salicylates, and, as a rule, showing its benefit in the rheumatic by relieving pain and lowering temperature, yet its curative action is by no means to be forgotten or ignored. In such cases of rheumatism the proper dose is from 4 to 6 grains three times a day.

The opinion held by many that acetanilide is inferior to antipyrine as an analgetic is probably true, though its inferiority is so slight as to be more than compensated for when we remember the marked advantages which it possesses over antipyrine. Thus, the size of its dose, its freedom from taste, with the consequently greater ease of administration, are in marked contrast with the properties possessed by antipyrine. Greater, however, than these and, even without them, sufficient to prove its superiority is its infinitely greater freedom from untoward effects.

A marked advantage which acetanilide in common with others of its class possesses over other analgetics, and a consideration of the greatest importance when a drug is to be used with considerable frequency, is the absence of the danger of acquiring a habit from its use.

Though the relief of neuralgic pain is the action by which acetanilide shows its most marked effectiveness, it is often of value, too, in conditions of spasm, tremor, and reflex irritability, and though in almost all the conditions to be mentioned we have other drugs which possess more reliable and constant curative properties, its use when a substitute is necessary will often prove of great value. Thus in some cases it will be of use in relieving the *tremors associated with multiple sclerosis of the spinal cord.*

In *chorea* it not infrequently exerts a controlling influence over the muscular spasm, and, though by no means a specific like arsenic, and therefore not to be held as a substitute for that drug, it is at times a valuable adjuvant.

Acetanilide has been recommended as an *antispasmodic* in *asthma* and in *whooping-cough*, and, though it occasionally exerts some slight beneficial effect in these conditions, its action is certainly neither constant nor reliable, and its use for such cases simply represents the constant endeavour of therapeutists to find satisfactory and reliable means by which to combat conditions unusually defiant of relief.

Acetanilide has been largely used in the treatment of *epilepsy*, and though opinion is much divided and markedly contradictory as to its value in this condition, there seems to be no doubt that it does exert a controlling influence upon the attacks by no means inconsiderable. It has long been the effort of neurologists to find a means of treating epilepsy which would not be in itself of disadvantage and in certain ways of harm to the patient, as the bromides are. Such a place it was hoped that acetanilide would fill, but careful experiment and patient employment of the drug have utterly failed to demonstrate a usefulness in any way approaching that of the bromides. Some cases, indeed, are relieved, the attacks being made less frequent and less severe, but such action is relatively infrequent as compared with that of the bromides, and the beneficial effects of the drug can not be counted upon. It seems probable, however, that of epileptics those in whom plethora is present and those in whom the attacks are diurnal are the more benefited by the administration of acetanilide.

Acetanilide has been given as a *hæmostatic* to check epistaxis and hæmoptysis. but of such use the most that can be said is that it probably does little harm.

It has been suggested that acetanilide be used in *lobar pneumonia*, with the idea that in such cases it will not only act as an antipyretic, but also have a specific and curative action upon the pathological condition. Of this suggestion little need be said, for of the value of acetanilide so employed all proof is wanting. The use of acetanilide in lobar pneumonia in the earliest period of the disease and in the presence of high temperature and sthenic symptoms is perhaps justified, though even at this time other procedures would appear safer; but, apart from its failure of specific action, it would certainly appear unwise to employ an antipyretic which clearly has a depressing effect upon the circulation in a self-limited disease in which the temperature is seldom a dangerous symptom, but in which circulatory failure is always to be feared and in fatal cases is the usual cause of death.

As a local application acetanilide has been little used, and such use as it has had has not shown it to be possessed of qualities of any great value. As a dressing for chancre and chancroid it has proved disappointing and in no way comparable in effect to iodoform, iodol, or black wash.—Henry A. Griffin.

ACETBROMANILIDE.—See Bromacetanilide.

ACETIC ACID.—An organic acid, $C_4H_6O_2$, which constitutes the acid principle of vinegar. It is most commonly employed in the form of vinegar, which is one of the sources from which it is obtained, although the varieties derived from the oxidation of alcohol and from crude pyroligneous acid are more commonly met with. At moderately low temperatures the pure acid is crystalline, and at somewhat higher temperatures becomes a colourless, volatile liquid known as glacial acetic acid. Its poisonous effects are similar to those of most other acids, but much less marked, great irritation of the mucous membranes with which it may come in contact being the rule rather than corrosion or destruction of them. The symptoms observed in cases of poisoning, which, however, are very rare, are pain in the throat and stomach, nausea, vomiting, and purging. Alkalies and demulcents are the proper remedies to combat these conditions. A too prolonged use of the acid is followed by impairment of the digestion and by other effects, which will be described under Vinegar.

In cases of *poisoning by the caustic alkalies* the diluted acid can be used as an antidote with perfect safety, as the salts it forms with them are unirritating and, as a rule, cathartic. It combines with most of the bases to form the acetates—salts which are in most instances freely soluble in water and easily absorbed. The acetates of the alkaline bases are diuretic, slightly diaphoretic, refrigerant, and in considerable quantities cathartic. Like nearly all the combinations of the organic acids and the alkaline bases, they are converted into carbonates during the process of absorption, and hence render the fluids of the body more or less alkaline. The acid itself enjoys this property to a slight degree on account of its combining with these bases within the body. The glacial acid, applied by means of a stick or a glass rod, is employed to destroy *warts, corns, condylomata*, and *fungous growths*. The crystalline form is rarely employed, except in the preparation of so-called "smelling salts," a favourite combination of this sort being one with potassium sulphate, from which the vapours of acetic acid are slowly evolved. The inhalation of acetic-acid vapour will sometimes abort an incipient cold, relieve *headache*, and restore consciousness after *fainting*. The diluted form is mildly astringent and hæmostatic, relieves itching of all kinds, and is an agreeable addition to baths in hot weather. For the latter purpose aromatic vinegar is the form in which it is very generally employed, but caution must be observed that when metallic bath tubs are used the solution is not too strong and that none of it is allowed to remain in the tub for any length of time, as it affects metals somewhat. The strong acetic acids of the different pharmacopœias all contain about one third of the pure acid, and are rarely used except as caustics, as styptics, and in the treatment of *ringworm* and *pityriasis*. The dilute acid is somewhat stronger than ordinary vinegar (the U. S. Ph. orders a six-per-cent. solution of the absolute acid), and may be substituted for it. Acetic acid or vinegar enters into a number of official preparations, in all of which the other ingredients are the active ones. See Chloracetic Acid, Dichloracetic Acid, Trichloracetic Acid, and Vinegar.—Russell H. Nevins.

ACETIC ALDEHYDE.—See Aldehyde.

ACETIC ETHER, the *æther aceticus* of the pharmacopœias, ethyl acetate, $CH_3CO.OC_2H_5$, is a colourless, transparent, fragrant liquid, of an acetous and burning taste, prepared by distilling together, according to the Br. Ph., 32¼ imp. fl. oz. of rectified spirit, 32½ imp. fl. oz. of sulphuric acid, and 40 oz. (av.) of sodium acetate. The acid and the alcohol are mixed slowly, and the sodium acetate is added when the mixture has become cold; 45 imp. fl. oz. are distilled off, and the distillate is digested for three days in a stoppered bottle with 6 oz. (av.) of freshly dried potassium carbonate; the ethereal liquid is then separated and again distilled until all but about 4 fl. oz. has passed over. The product is to be kept in well-stoppered bottles in a cool place. It is inflammable, and mixes in all proportions with alcohol and with ether. Acetic ether has been used as an *anæsthetic*, but its action is feeble. As a *stimulant* and *antispasmodic*, it may be given in doses of from 5 to 20 drops, well diluted with water, or inhaled, especially in cases of *faintness* or threatening *collapse*. It is also used externally, with friction, for the relief of *rheumatic pains*.

ACETONE, pyroacetic ether or spirit, $CH_3.CO.CH_3$, is a colourless, inflammable liquid, of a fragrant, mintlike odour and a pungent, sweetish taste, prepared by the dry distillation of an acetate. It mixes readily with water, alcohol, ether, chloroform, or volatile or fixed oils. It is now little used in medicine, but was formerly given in gout, in pulmonary tuberculosis, and as an anthelminthic. It is said to be feebly anæsthetic.

ACETOPHENONE, phenylmethyl ketone, or hypnone, $C_6H_5.CO.CH_3$, is prepared by the dry distillation of a mixture of calcium benzoate and acetate and subsequent fractional distillation. It is a colourless, mobile, pungent liquid, of a disagreeable odour, insoluble in water, soluble in alcohol, ether, glycerin, or the essential oils. It is used as a *hypnotic* in doses of 1 to 5 minims, dissolved in oil and inclosed in capsules.

ACETPHENETIDINE.—See Phenacetine.

ACETUM.—Vinegar. The medicated vinegars, *aceta medicata*, the *acétolés* of the French, are mostly made by macerating vegetable drugs (rarely animal or mineral substances) in vinegar or, better, in dilute acetic acid, percolating, expressing, and filtering. The more important of them will be mentioned in the article on Vinegar or under the names of drugs that appear in their titles.

ACETUM PYROLIGNOSUM.—See Pyroligneous Acid.

ACETYLALDEHYDE.—See Aldehyde.

ACETYLAMIDOBENZENE.— See Acetanilide.

ACETYLAMIDOPHENOL.—A colourless, amorphous substance, $C_{16}H_9NO_4$, but slightly soluble in water, but readily soluble in alcohol or strong acetic acid. It has been used as an *antipyretic* in capsules containing from 3 to 8 grains each.

ACETYLAMIDOSALOL. — This compound, which crystallizes in brilliant lamellæ, has been suggested as a substitute for salol, over which it is said to have the advantage of not being poisonous. It is but sparingly soluble in water, but dissolves freely in alcohol or benzene.

ACETYLMETHYL.—See Acetone.

ACETYLPHENYLHYDRAZINE. — See Hydracetin.

ACETYLTANNIN, or tannigene, is described as a tannic-acid substitution product of hydroxyl acting somewhat less energetically as an astringent than tannin, but having the advantage of remaining undissolved in the stomach and acting only on the intestine when administered by the mouth.

ACHILLEA.—Yarrow, a genus of the *Anthemideæ*. *Achillea Millefolium* (the entire plant) is mildly aromatic, astringent, tonic, and diaphoretic, and has been considered emmenagogue. The dose of an infusion of 1 oz. in 1 pint of hot water is from 4 to 6 fl. oz. The expressed juice has been used in doses of from 1 to 2 fl. oz., three times a day. *Achillein*, a bitter principle obtained from the plant, is said to have caused irregularity of the pulse. *Achillea nobilis* is sometimes used instead of *Achillea Millefolium.*

ACIDS.—The acids whose action depends upon their inherent properties rather than those of the bases from which they are derived are the mineral acids, hydrochloric, nitric, nitrous, nitrohydrochloric, sulphuric, and, to a certain extent, phosphoric, and the vegetable acids, acetic, citric, and tartaric.

The *mineral acids* all have a strong affinity for water, and consequently are corrosive and destructive to animal tissues and are used as caustics, more especially nitric and sulphuric acids. (Cf. Caustics.) When freely diluted they relieve the itching of urticaria and other forms of *pruritus*, are *astringent* and *hæmostatic*, diminish the amount of all normal and pathological acid secretions, and act as general stimulants of the skin and raw surfaces. When they are taken internally in a more or less concentrated condition their effects upon the mucous membranes are escharotic. If after the taking of considerable amounts death does not occur shortly, the affected parts contract, causing deformities of the mouth and strictures of the œsophagus and stomach. The members of this group which are most commonly the causes of accidental or intentional poisoning are nitric and sulphuric acids, on account of the ease with which they are obtained and their extensive uses in the arts. The local effects of these are easily to be distinguished by the yellowish stain upon the face or in the mouth left by nitric acid and the black, carbonized appearance caused by sulphuric acid. Whichever of the mineral acids may be the cause of poisoning, the symptoms are practically the same, and so is the treatment. Severe burning pain in the mouth, throat, and stomach, nausea, vomiting (of blood in severe cases), colic, tympanites, and diarrhœa are the most marked symptoms, due to the contact of the acid with the tissues. In addition, the effects upon the general system are profound, the action of the heart being depressed and the respiration hurried, and general collapse and coma occurring unless the destruction of the tissues has been sufficiently extended to be the direct cause of death. Without the assistance of collateral circumstances and the visible corrosive action of the acid there is little to distinguish these cases from poisoning by the caustic alkalies or highly corrosive salts. Probably the most distinctive point of difference between poisoning by acids and that by alkalies is the slight effervescence caused by the vomited matters in the former case if they come in contact with a carbonate, and in some cases when they are ejected upon the earth. The chemical antidotes to all acids are the alkalies and their carbonates, of which magnesia is by far the best, on account of its great combining properties. The carbonates are not so desirable, as the distention caused by the carbonic-acid gas which they give off when in contact with acids may be sufficient to rupture the walls of the stomach or intestines, already weakened by the corrosive action of the acid, but, if nothing else is at hand, they must be used. The antidote most easily obtained is plaster from a wall, which can be easily detached and coarsely powdered. Soap may be used in an emergency, but is not very efficient. Whatever is used, it must be given promptly, but when a caustic alkali is employed care must be taken that an excess is not used, as the surplus over what is necessary to neutralize the acid will have a corrosive effect. Oil, milk, and eggs protect the unaffected tissues in a measure, and are to be freely given after the alkali. The constitutional symptoms are to be combated by opium, alcohol, the application of dry heat, etc. As a rule, it will be found necessary to administer by the rectum all medicines which can not be given hypodermically, and all forms of nutriment should be given in the same way until the most active symptoms have subsided. After the acute stage has been passed the treatment is to be conducted upon general principles. Treatment of the injuries caused by the contact of acids with the surface of the body does not differ from that appropriate in cases of burns, except that alkalies must be employed at once to neutralize the acid, and fatty matters applied around the injured parts to prevent an extension of its action.

The undiluted mineral acids are never used internally except as caustics in those cavities of the body readily accessible from the exterior. Diluted, they increase the secretion of all the mucous surfaces with which they may come in contact, and thus play an important part in allaying thirst, are astringent and hæmostatic, and diminish the amount of free uric acid which may be present in the urine. When taken before eating or upon an empty stomach they diminish in a marked degree the acid secretion of the stomach, and, used at such times, are of great benefit in the treatment of *acid dyspepsia*, but, taken after eating, they simply add to the amount of free acid already present and aggravate the dyspepsia. *Cholera* germs are said to be destroyed by them, and they are added, more especially sulphuric acid, to drinking water during the prevalence of epidemics of Asiatic cholera. The effects upon the teeth when any form of acid is employed are disastrous unless precautions are observed to prevent its contact with them. The acids should be given through a glass tube bent in such a manner that it reaches far back upon the tongue, and after each dose it is wise to rinse out the mouth with a weak alkaline solution, none of which should be swallowed, as the desired effects of the acid might be counteracted.

Of the *vegetable acids*, none except acetic are sufficiently strong to be of any value as escharotics, and in excessive doses they are

irritant rather than corrosive. Poisoning may be said never to occur, and the colic, etc., due to an overdose of any of these may be relieved by alkalies. Their internal effects are very similar to those of the mineral group, but they are less efficient, and are rarely employed like the latter. The salts which they form are, as a rule, freely soluble in the ordinary menstrua and readily absorbed. Their combinations with the alkalies are diuretic, diaphoretic, and in large doses cathartic, and, since during the process of absorption and assimilation they are converted into the carbonates, they increase the alkalinity of all the fluids of the body. Any one of either the mineral or vegetable acids may be used as the chemical antidote in cases of poisoning by alkalies, but the vegetable ones are rather better on account of the unirritating and cathartic properties of their alkaline salts.—Russell H. Nevins.

ACONITE, the *aconitum* of the U. S. Ph., is the tuber of *Aconitum napellus* (monkshood). The Ger. Ph. permits only the aconite roots (*tubera aconiti*) to be used in the preparations it authorizes. The Br. Ph. and the Fr. Cod. employ both the root (*radix*) and the leaves (*folia*), however, and by the latter *Aconitum ferox* is recognised as well as *Aconitum napellus.* A remarkable resemblance exists between aconite root and that of horse-radish, a resemblance which has often resulted in fatal poisoning. The two roots may be distinguished by the fact that the horse-radish when scraped emits its peculiar odour, while aconite emits none. [Of the proximate principles of aconite, only aconitine is of therapeutic importance, and that will be the subject of the next article.]

In the internal administration of aconite its effect is seen in producing at first a sense of tingling and prickling of the tongue, lips, and mouth, followed soon by a feeling of numbness of considerable duration, these sensations being due to a purely local action of the drug. After a variable period of time, usually not longer than half an hour, the general symptoms, due to the absorption of the drug, make their appearance. A sense of numbness and partial anæsthesia of the face is experienced, and subsequently of the extremities, though it may be present throughout the body if the dose administered has been sufficiently large. The heart's action becomes reduced both in force and in rapidity. The respiration is slowed, a sense of general relaxation is experienced, the skin becomes moist and perspiring, the amount of urine is increased, and, if fever has been present, it is lowered. These symptoms mark the full therapeutic effect of the drug, the occurrence of manifestations more marked denoting poisoning.

If a poisonous dose has been administered the symptoms make their appearance, as a rule, more promptly than after a therapeutic dose, the rapidity of their development generally depending upon the size of the dose. Thus, following a dose of large size, poisoning may at times be recognised within five minutes. The symptoms occurring after poisonous doses are simply marked exaggerations of those produced by the therapeutic use of the drug. The same tingling is experienced in the mouth and throat and rapidly becomes numbness; with great rapidity the numbness spreads to the face, to the extremities, and then throughout the body, and may be so marked as to result in a condition of general cutaneous anæsthesia, though previous to this decided pain may be experienced, especially in the face. With the development of these disturbances of sensation the patient experiences an overpowering weakness and relaxation, ultimately amounting even to complete loss of the power of motion. The heart's action is decidedly reduced in rapidity and force, but later is generally rapid, feeble, and irregular. The pulse is exceedingly compressible, then rapid and running, later imperceptible. The respirations are at first slowed, then become shallow and laboured. The face is pinched, the eyes generally protrude, though sometimes they are sunken, and the pupils are dilated. The skin is pallid in the extreme, cold, and covered with moisture. The temperature falls decidedly. In some cases vomiting is present, and in some, too, spasmodic purging. Epileptoid convulsions may be seen, though their occurrence is not common. The mind usually remains entirely clear. Though aconite paralyzes both respiration and circulation, death usually results from arrest of the heart in diastole, the fatal syncope in some cases having been determined by some exertion on the part of the patient.

In the treatment of a condition so grave as *aconite poisoning* our whole endeavour must be toward stimulation and the prevention of syncope. For these purposes the patient is to be kept recumbent, and it is wise to elevate the foot of the bed or table on which he lies, that with the elevation of his extremities there may occur a determination of blood to the vital nervous centres. Warmth is to be applied to his extremities and surface generally by means of hot-water bottles and bags, cloths wrung out in hot water, hot bricks, etc. Stimulants should be administered freely, and, for the greater rapidity of action, are to be given by hypodermic injection. For this purpose the more diffusible stimulants are first to be employed, especially ether, camphor, and ammonia in some form; later alcohol, and then those drugs which, while more slowly absorbed, are yet of more prolonged action, especially atropine, strychnine, digitalis, and strophanthus. If the patient is not vomiting, stimulants may be given by the mouth, provided the condition is not so grave as to require the more rapidly acting hypodermic method, or provided the immediate danger has been relieved by that means. That emetics are not to be given it seems unnecessary to say, but the emptying of the stomach by the gastric siphon has been recommended. Whether or not this is to be employed will depend entirely upon the patient's circulatory condition. If the tube can be used before marked symptoms of cardiac weakness appear it should certainly be employed, and if the circulation can be sustained by stimulation its use is then indicated, but in using it

great care must be exercised lest the procedure result in that cardiac weakening which it is the whole object of our treatment to prevent.

Though the physiological action of aconite when given internally is not definitely established in many of its details, the following explanations are generally accepted:

On the circulation aconite in therapeutic doses exercises a sedative effect, diminishing both the force and the rapidity of the heart's action and thereby lessening blood pressure. In poisonous doses this action is increased, and ultimately the heart is arrested in diastole. This depressing power upon the heart is supposed to depend upon the direct action of aconite upon the heart muscle.

On the respiration aconite also exerts a depressing influence, slowing the respiration and diminishing its depth. It is, in poisonous doses, a paralyzer of respiration, both by an action upon the respiratory centre and by a direct effect upon the muscles of respiration.

The temperature is reduced by aconite by means of the increased heat radiation resulting from the greater amount of blood contained within the relaxed capillaries of the skin as well as by evaporation resulting from the increased perspiration.

Upon the nervous system aconite exerts an influence most marked. Its main action is upon the sensory nerves, whose end organs under its administration lose their functional activity. If large doses are administered this depression may extend to the nerve trunks, to the centres in the spinal cord, and even, according to some authors, to the perceptive centres in the brain. As a result of these effects, reflex action is diminished. On the motor nerves aconite acts only when given in poisonous doses. Then as a late symptom there may be motor paralysis as a result of a paralyzing action upon the motor tract of the spinal cord and the motor nerves.

The urine is increased by aconite, especially if there has previously been a febrile diminution.

The skin shows the effect of aconite by a marked increase in the amount of perspiration.

Doses of some size increase gastro-intestinal secretion, and, if gastric and intestinal irritability is present, digestive disturbance with diarrhœa may result.

Locally applied, aconite exerts a benumbing and local anæsthetic effect upon mucous membranes, and, after longer contact, upon the skin. These results occur from the specific effect of the drug upon the sensory end organs.

In administering aconite by far the most valuable preparation, as well as the most reliable, is the tincture. Of this, from 1 to 5 minims may be given, according to circumstances. If the purpose in giving aconite is to produce its effects upon the sensory nerves the larger doses should be employed, and repeated according to necessity, usually not oftener than three or four times a day. If the object is to lessen the symptoms of the febrile state, then it is wiser to use the smaller dose, or, better yet, to give fractional doses (from $\frac{1}{4}$ to $\frac{1}{2}$ a minim) of the tincture every quarter or half hour until the temperature falls, the circulatory excitement is lessened, and the skin becomes moist, or until the tongue and lips tingle. The doses may then be given at longer intervals. In giving aconite it should be largely diluted ($\frac{1}{2}$ minim to a teaspoonful of water is a sufficient dilution), on account of its decided local effect upon mucous membranes. From a therapeutic dose of aconite we expect to observe action in about half an hour, and this action, as a rule, lasts about three hours. The main indication for its administration is vascular excitement in the sthenic; its contra-indications are asthenia and adynamia, cardiac degeneration or dilatation, weak heart action from any cause, and gastro-intestinal irritation or inflammation. It is in no way a drug for use in continued fevers, and its prolonged use is not indicated save on the rarest occasions.

Aconite has for a long time held a high place in the esteem of most practitioners, but opinion is by no means unanimous upon its worth, and by many its value is as severely questioned as it is by others highly estimated. Doubtless much of the adverse criticism is, as Edes points out, due to its burlesque employment by the homœopathic school as well as to the natural tendency to rapid spontaneous cures in those affections in which aconite finds its commonest application. There seems to be no doubt, however, of the great value of the drug in certain conditions—conditions in which even the modern antipyretic drugs have failed beyond a certain point to replace it.

Those *fevers in children* so commonly the result of exposure, often associated with inflammations of the tonsils, pharynx, and bronchi, and accompanied by marked circulatory excitement, constitute a set of affections in which aconite shows its greatest usefulness. In such cases the fractional doses, given as has already been described, soon result in a fall of temperature, circulatory sedation, the establishment of perspiration, and amelioration of all accompanying symptoms. Yet its effectiveness is not confined to these diseases as seen in children, although from the relatively greater frequency of such disorders in early years its use in children is more common. In all inflammatory febrile conditions, however, it is in the early and sthenic period that aconite is indicated, its later use in the absence of dynamic conditions being as potent for harm as it is earlier for good.

In the same way is aconite useful in *coryza*, *acute otitis*, *quinsy*, and *asthma* due to exposure. In *croup*, both catarrhal and spasmodic, it is exceedingly effective, relieving the dyspnœa of the latter usually within a few hours.

In *simple fever*, *febricula*, or *catarrhal fever*, then, is the use of aconite as a febrifuge and sedative mainly to be recommended, and yet it may occasionally be well to use it for these purposes in other febrile disorders. Thus, while it should not be employed regularly in the *continued fevers*, its occasional use for hyperpyrexia occurring in them and attended by vascular excitement is often most judicious. In *scarlatina*, *measles*, and *erysipelas* its occasional use in the presence of febrile and circulatory indications is often valuable in

modifying the severity of the symptoms, reducing the temperature, and increasing the action of the kidneys and skin. It is to be recollected, however, that the effort to reduce temperatures persistently high by the use of aconite requires the employment of such doses as in themselves to constitute an element of great danger, even were such cases not more effectively relieved by other means.

A class of diseases much benefited by the use of aconite in the early stages is seen in *acute inflammations of the serous membranes.* Thus *meningitis*, either cerebral, spinal, or the combination of both, seen in epidemic form may well be treated in its early stages by the small and frequently repeated doses of tincture of aconite already mentioned. *Acute pleurisy*, too, before the stage of exudation, is in like manner improved. *Acute peritonitis*, either pelvic or general, presents the same indications, and, though in general peritonitis the addition of opium in doses of considerable size is usually indicated, yet this in no way interferes with the good effect of the aconite. In *pericarditis* of acute type the aconite treatment of the early stages not only serves its usual purpose, but also has the additional and great value of contributing more directly to a curative result by its marked power of slowing the heart's action.

In *diseases of the respiratory organs* aconite seems especially indicated from its sedative effect upon respiration, and, though in bronchitis this effect is comparatively unimportant, in pneumonia it is a quality of the greatest value. In either *lobar pneumonia* or *broncho-pneumonia* in its earliest stages the greatest relief will often follow the administration of tincture of aconite in doses of 1 minim every hour until numbness of the lips and tongue occurs, after which its less frequent administration will maintain the good effect. Indeed, there are those who administer aconite throughout the course of pneumonia, so firm a belief have they in its efficacy, in defiance of the fact that in all but the earlier stages of pneumonia it is circulatory slowing, strengthening, and stimulation that are needed, not the depression and weakening of a heat whose very over-action shows its weakness.

It has been taught that the *fever of tuberculosis* is benefited by aconite given in doses of 1 minim of the tincture every hour till its effects are seen, and, though it is true that by this treatment the temperature may be reduced, it is accomplished at the expense of undesirable sweating and the necessity of the continued administration of the drug in a disease essentially asthenic in its nature.

In *acute articular rheumatism* aconite will often be of service, and especially in those cases in which perspiration is absent and the skin hot and dry. In such cases it not only exerts to some extent its anæsthetic effect, but by a reduction of temperature and a re-establishment of the functions of the skin often produces marked amelioration in the symptoms of the disease.

Its action in *muscular rheumatism*, especially if accompanied by fever, is similar and its effectiveness even more marked.

In *chronic rheumatism* and in *gout* it is occasionally of service for its anæsthetic effect, but in chronic rheumatism it must be given with discrimination, lest by prolonged use it be the cause of untoward effects upon the circulation. To be effective in such cases it should be given in the form of the tincture in doses of 1 minim every hour until some numbness of the lips and face or even of the extremities results, when this effect is to be continued by its less frequent administration.

In *neuralgia* aconite has been much employed, and is generally of great service from its benumbing effect upon the peripheral nerves, but it is in the so-called rheumatic neuralgia which follows exposure to cold and wet that it is most effective, and especially if the attack is accompanied by vascular excitement.

From its efficiency in controlling and reducing the rate and force of an overacting heart, tincture of aconite will often be of service if given in doses of from 2 to 4 drops three times a day in *exophthalmic goître*, *palpitation from nervousness*, and "*smoker's heart*." In hypertrophy of the heart without valvular disease it is also useful, and even if valvular disease is present it may be cautiously employed to control the overforcible action of excessive hypertrophy. If dilatation is present, however, or if the heart muscle is degenerate, its use is absolutely contraindicated.

In *congestive dysmenorrhœa* aconite will often afford prompt relief, and in the sudden suppression of menstruation from exposure it is equally effective if given in small and repeated doses to the extent of producing the full therapeutic effect.

In the early stages of *gonorrhœa* it may be given in doses of 1 drop of the tincture every hour till its usual effects are produced (Ringer). In such cases it appears to cause a lessening of the severity of the inflammation and to act distinctly in the prevention of chordee. In *urethral fever*, too, it is said to be very effective.

Aconite will generally be of benefit in controlling the *epistaxis* of full-blooded people, and if given in fairly large doses may serve to relieve the *vomiting of pregnancy*, presumably by its action on the sensory nerves and its power to reduce reflex irritability.

Aconite, by virtue of its action as a local anodyne and anæsthetic, is frequently of use in *neuralgia*. In such cases it may be applied in ointment (2 grains to 1 drachm) or liniment, or the tincture, alone or in combination with other remedies, may be painted over the painful area. Thus applied, a combination of equal parts of the tinctures of aconite and of gelsemium is often found of use.

For *vague rheumatic and neuralgic pains* the addition of aconite to liniments will often add to their effectiveness.

Local applications of tincture of aconite will also be found useful in relieving *pruritus* and the burning of *chilblain*.

In *toothache* a few drops of tincture of aconite rubbed on the gum in the neighbourhood of the diseased tooth will frequently give relief, or it may be introduced into the carious tooth upon cotton.

It is to be remembered in using aconite as a

local application that it is absorbed by the broken skin, and its employment under such circumstances is invariably to be accompanied by the greatest caution.

Aconite as such is not employed in medicine. The extract (*extractum aconiti* [U. S. Ph.]) is made from powdered aconite by macerating it with alcohol, percolating, and evaporating. It is an extract of pilular consistence. The dose is from ¼ to ½ grain. In the Br. Ph. *extractum aconiti* is directed to be made from the leaves. An *extractum aconiti* made from the root is authorized by the Ger. Ph. Its maximum single dose is ⅓ of a grain. The Fr. Cod. authorizes extracts both of the root (*extrait de racine d'aconit*) and of the leaves (*extrait des feuilles d'aconit*). The fluid extract (*extractum aconiti fluidum*) is obtained from powdered aconite by macerating it with alcohol and water, percolating it, and diluting with alcohol and water to the required standard. The dose is from 1 to 2 minims. The tincture (*tinctura aconiti* [U. S. Ph.]) is prepared from powdered aconite by macerating it with alcohol and water, percolating, and adding alcohol and water to the required standard. The dose is from 1 to 5 minims. The *tinctura aconiti* of the Br. Ph. is prepared from aconite root, and contains 54½ grains to 1 fl. oz. The Ger. Ph. authorizes a 10-per-cent. tincture made from the root, of which it gives the maximum dose as 8 grains. Tinctures of the root (*teinture de racine d'aconit*) and of the leaves (*teinture de feuilles d'aconit*) are authorized by the Fr. Cod.

Fleming's tincture of aconite is a non-official preparation which is sometimes employed. It is much stronger than the official tincture, and its use is not to be recommended, both on account of its unnecessarily great strength and from its offering no advantage over the official preparation.

The *alcoolature d'aconit* of the Fr. Cod. is a preparation similar to the fluid extract of the U. S. Ph., made by macerating the bruised aconite in alcohol, with occasional agitation, for ten days, and then filtering with pressure. Two preparations are made thus—one from the leaves, the other from the root. The *sirop d'aconit* (*syrupus de aconito* [Fr. Cod.]), syrup of aconite, contains 25 parts of the alcoolature of aconite root and 975 of syrup. The aconite liniment (*linimentum aconiti*) of the Br. Ph. is made from 20 oz. of powdered aconite root, 1 oz. of camphor, and enough rectified spirits to make 30 fl. oz.

To the names of aconite and its official preparations the word *radix* (signifying root) or its genitive, *radicis*, was formerly added as a means of distinguishing the preparations of the root from those of the leaves, which were at that time official. The leaves being no longer recognised by the United States Pharmacopœia, since in their action they have been found unreliable, the use of the word radix has become unnecessary and superfluous.—Henry A. Griffin.

ACONITINE, *aconitina* (Br. Ph.), or *aconitinum* (formerly also *aconitia*), is not official in the United States.

The chemistry of *Aconitum napellus* is not yet well understood, but it is believed to contain several alkaloids, and among them aconitine and napelline (though by some napelline is believed to be merely a weaker form of aconitine), existing in combination with a peculiar acid known as aconitic acid. Though napelline has been used to some slight extent in medicine, aconitine is by far the most important principle of the plant; on its presence depends the action of aconite itself.

In aconite, aconitine is found both in an amorphous and in a crystalline form. The crystalline form appears as colourless, rhombic, tabular crystals, soluble in alcohol, chloroform, or ether, and but very slightly soluble in water. With acids aconitine forms crystalline salts.

As has already been said, it is to the presence of aconitine that aconite owes its activity, and according to the quantity of the aconitine contained in aconite root the preparations made from that root vary in potency, circumstances of growth and cultivation producing the greatest variation in strength. To these facts are due the diversities in power of the preparations of aconite.

With the exception of its vastly greater potency and activity, the action of aconitine is the same as has already been described in speaking of aconite. It is one of the most powerful and virulent poisons known, when pure even exceeding hydrocyanic acid in potency. Its action in poisonous doses is exceedingly rapid, and if the drug is given by hypodermic injection it is said that it may result fatally in less than a minute. Poisoning by aconitine is to be treated in the same manner as poisoning by aconite.

The tremendous potency of aconitine would alone seem a sufficient argument against its internal use, especially when we consider that aconite itself is to be used in small doses and with great caution, together with the fact that the advantage of using aconitine rather than aconite is not apparent. But in addition to these objections to its internal use must be noted the great variation in the strength of the aconitines, according to their source of manufacture, and the consequent great danger of prescribing them. Thus, the ordinary commercial aconitine is merely a mixture of alkaloids, exceedingly impure and (yet more important) subject to great variation in strength. The German aconitine, too, is very impure, as is the "impure English aconitine."

[The aconitine of the Br. Ph. is prepared by mixing any convenient amount of aconite root, in coarse powder, with twice its weight of rectified spirit, heating the mixture until it begins to boil, cooling and macerating for four days; transferring the whole to a displacement apparatus and percolating, with the addition of more spirit as may be required, until the root is exhausted; recovering most of the alcohol by distillation and driving off the remainder of it over a water-bath; mixing the residual extract thoroughly with twice its weight of boiling distilled water, and, when it has cooled, filtering through paper; adding a slight excess of solution of ammonia and heating gently

over a water-bath; separating the precipitate on a filter and drying it; macerating it, in coarse powder, in successive portions of pure ether, with frequent agitation; decanting and mixing the several products and distilling off the ether until the extract is dry; dissolving the dry extract in warm distilled water acidulated with sulphuric acid; precipitating, after the solution has cooled, by the cautious addition of solution of ammonia diluted with four times its bulk of distilled water; and washing the precipitate on a filter with a little cold distilled water and drying it by slight pressure between layers of filtering paper and subsequent exposure to air.]

An English aconitine is prepared by Morson from the artificially cultivated root, and is said to be chemically pure. It is terribly powerful, even $\frac{1}{1000}$ of a grain being said to cause numbness of the tongue. The aconitine of Merck is said to be reliable, but the preparation most generally employed and the one of most constant strength, and hence most trustworthy, is Duquesnel's. This is, strictly speaking, not aconitine, but a crystalline nitrate of aconitine, and, though from its virulence as a poison no form of aconitine is to be recommended for internal use, and $\frac{1}{40}$ of a grain of this preparation has been followed by alarming results, yet, should the alkaloid be used, the crystalline aconitine of Duquesnel is the only form in which it should be employed.

The internal use of aconitine is practically limited to two conditions—neuralgia and pneumonia.

In *neuralgia*, especially of the trigeminus, the aconitine of Duquesnel may be administered in the dose of from $\frac{1}{300}$ to $\frac{1}{250}$ of a grain, and repeated cautiously and very carefully increased. In such cases it is often, though by no means invariably, effective, but possesses no marked superiority over other means of treatment at our command.

In *pneumonia* aconitine has recently been largely used in conjunction with digitaline and arsenate of strychnine, and the combination is at times referred to by the name of "the trinity pill." Opinion is scarcely unanimous upon its efficiency in this disease, but in the pneumonia accompanying influenza it appears to be unusually valuable. Delafield reports that in the cases with a disposition to general venous congestion and failure of the heart's action he has obtained the best results by the combined use of $\frac{1}{4}$ of a milligramme of digitaline, $\frac{1}{6}$ of a milligramme of aconitine and $\frac{1}{2}$ a milligramme of arsenate of strychnine, together with whisky.

Even the local use of aconitine is not free from danger, and it should be employed most carefully, and never over a denuded surface. In the form of an ointment (2 grains to a drachm) or of a 2-per-cent. solution of the oleate of aconitine in oil it will, if locally applied, often afford marked relief in *neuralgia*. Similar preparations have been used for the relief of the pains of *gout* and *chronic rheumatism* and *myalgia*, but have no advantage over the safer preparations of aconite. [The *unguentum aconitinæ* of the Br. Ph. is made by dissolving 8 grains of aconitine in $\frac{1}{2}$ fluid drachm of rectified spirit and mixing the solution thoroughly with 1 oz. of benzoinated lard.] *Pruritus* has been benefited by its external application in ointment or solution, but other applications are not only quite as effective, but decidedly safer, especially in the presence of the scratched skin, the usual accompaniment of pruritus.—HENRY A. GRIFFIN.

ACORNS.—The fruit of various species of oak; of the Austr. Ph. (*semen quercus*), that of *Quercus pedunculata* and *Quercus sessiliflora;* of the Fr. Cod. (*gland doux*), that of *Quercus ballota*. The kernels contain nearly 40 per cent. of starch and nearly 10 per cent. of tannin, together with a fixed oil, an uncrystallizable sugar, quercite (a sugar resembling mannite), citric acid, and traces of an essential oil. The pharmacopœias direct the kernels to be dried and roasted, whereby they lose about half their weight and their starch is partly converted into dextrin. In this condition the acorns are infused like coffee (1 to 2 drachms to the cup), and "acorn coffee" is employed as an easily digested nutrient and as a mild tonic and astringent.

ACORUS CALAMUS.—See CALAMUS.

ACTÆA RACEMOSA.—See CIMICIFUGA.

ACTINOMERIS HELIANTHOIDES.—Diabetes weed, gravel weed, a North American perennial herb of the *Compositæ*. Its root has been used in *dropsy*, *chronic cystitis*, and *urinary lithiasis*, in the form of an ethereal tincture (1 part of the root to 2 parts of nitrous ether), the dose of which is from 1 to $1\frac{1}{2}$ drachm.

ACTIVE PRINCIPLES. — Plants and animals are made up partly of mineral or inorganic material, among which it is customary to include water and simple or compound gases, but most largely of organic compounds, in which carbon is associated with hydrogen and oxygen, and frequently with other additional elements, forming compounds which, when strongly heated, are more or less readily charred or decomposed.

Proximate Principles.—These organic carbon compounds which make up the larger proportion of an animal or plant are comprised under the general name *proximate principles*, because they are the first or proximate substances which are obtained when an organic body is split up into its component parts by solvents or other agents which produce no alteration in their nature. The art or process by which organic individuals are thus taken to pieces is called *proximate analysis*. The further reduction of these proximate principles to their elementary constituents, with the qualitative and quantitative determination of the latter, is called *ultimate analysis*.

Some of the substances now classed among the proximate principles were known and in common use, in a more or less pure form, for a long time before their chemical constitution was understood. The progress of chemical research, particularly during the last few decades, has increased their number to such an extent that a mere enumeration of them, so far as known, would occupy many pages.

All proximate principles which exert any recognisable action upon the human or animal organism, beyond that of sustaining life by nourishment, are comprised under the term *active principles*. Since this work is designed to treat only of those agents which have been or are now used therapeutically, a large number of proximate principles may here be left out of consideration altogether, either because they are not "active principles" in the true sense of the term (such, for instance, as the starches, sugars, albumins, etc., which are rather articles of food), or because, although "active principles," they have been tested only experimentally, or else because nothing whatever is known regarding their physiological effects or pharmacodynamic action.

In order to afford a comprehensive view of the several kinds of *active principles* it will be well to enumerate and briefly characterize the various classes or groups of *proximate principles*, and to mention under each group, where it may be found necessary, those which are therapeutic agents.

Classification of Proximate Principles.—Proximate principles are most conveniently classed into the following groups: 1, Carbohydrates; 2, Tannins; 3, Glucosides; 4, Neutral Principles; 5, Alkaloids; 6, Organic Acids; 7, Colouring Matters; 8, Resins; 9, Fixed Oils and Fats; 10, Waxes; 11, Volatile Oils; 12, Camphors; 13, Miscellaneous Compounds; 14, Protein Bodies; 15, Ferments.

I. *Carbohydrates.*—In their widest sense carbohydrates may be regarded as that class of organic bodies which constitute one of the first products of assimilation of the living plant by the interreaction of carbon and water. Accordingly they contain the elements carbon, hydrogen, and oxygen; and the two last-named elements are nearly always present in the same proportion as in water (rhamnose forms an exception, its composition being $C_6H_{12}O_5$). This large group may be subdivided into three smaller groups, viz.: (*a*) *Amyloids*, comprising cellulose, starch, dextrin, inulin (the peculiar starch existing in many plants of the natural order *Compositæ*), etc.; (*b*) *Sugars*, such as glucose, lævulose, lactose (milk sugar), maltose (malt sugar), saccharose (cane sugar), etc.; (*c*) *Gums and Pectin Bodies*, such as pectin, arabin, cerasin, bassorin, etc.

Nearly all the bodies belonging to this group are more properly to be regarded as articles of food than as remedial agents. Nevertheless, some of them produce valuable curative effects, due in most cases to their blandness, neutrality, and demulcent, lubricating, or soothing action.

II. *Tannins.*—A group of bodies containing only the elements carbon, hydrogen, and oxygen, in varying proportions, derived from various plants, and having the property of producing a blue or green colour with ferric salts. Most of them also have an astringent taste and form insoluble compounds with gelatin. Many crude drugs and preparations made from the latter owe their therapeutic effect to the presence of one or another of these tannins; thus, catechu to catechu-tannic acid or catechin. But there is only *one* of this group employed as a substance by itself—namely, gallo-tannic acid, the ordinary tannic acid of the shops.

Most of the tannins partake of the nature of glucosides, since they can be split up into a sugar and one or more other bodies.

III. *Glucosides.*—A group of bodies, mostly of a neutral character, which may be split up by the action of acids (also alkalies) into a sugar and one or more other bodies. Of the numerous glucosides thus far known only the following appear to deserve mention here:

Adonidin, from *Adonis vernalis* L.

Arbutin, from *Arctostaphylos Uva-ursi* (L.) Sprengel.

Convallamarin, from *Convallaria maialis* L.

Digitalein, digitin, and digitonin, from *Digitalis purpurea* L. (see below).

Glycyrrhizin, from *Glycyrrhiza glabra* L.

Salicin, from various species of *Salix* and *Populus*.

Strophanthin, from *Strophanthus hispidus* De Candolle, or more usually from *S. Kombé* Olivier.

Concerning digitalein and the other bodies mentioned above in connection with it, much uncertainty exists as to their being true chemical individuals and as to their relation to each other. The crystallizable principles obtained from digitalis are mentioned under the next group.

IV. *Neutral Principles.*—Among neutral or indifferent principles are classed a number of bodies of very varying composition and properties, which are chiefly characterized by the absence of any acid or basic character, or of properties which would assign them to any of the other groups. Many of these bodies possess a decidedly bitter taste, and have, for this reason, also received the name "bitter principles," or *amaroids*. Of this group the following are more or less in use as medicines:

Anemonin, from *Anemone Pulsatilla* L., and some allied species.

Cantharidin, from the blistering fly.

Cotoin, from coto bark, derived from an undetermined South American tree.

Digitalin. The only substance which appears to deserve receiving this name as a definite chemical body is Schmiedeberg's digitalin. There are two crystalline "digitalins" in the market—one known as Nativelle's, which consists chiefly of Schmiedeberg's digitoxin, the other as Homolle's, which consists mostly of Schmiedeberg's digitalin. There is also an amorphous German digitalin, which is likewise a complex body. These several digitalins differ greatly in strength and kind of action.

Elaterin, from *Ecballium Elaterium* (L.) A. Richard.

Kosin (or cussin, koussein), from *Hagenia abyssinica* (Bruce) Gmelin.

Picrotoxin, from *Anamirta paniculata* Colebrooke.

Piperin, from several plants of the natural order *Piperaceæ*.

Quassin, from *Picræna excelsa* (Swartz) Lindley.

Santonin, from *Artemisia pauciflora* Weber.

V. *Alkaloids.*—A large group of bodies hav-

ing basic properties, capable of forming crystallizable salts with acids. All but three of them contain oxygen, in addition to carbon, hydrogen, and nitrogen. The three which contain no oxygen (viz., coniine, nicotine, and sparteine) are volatile liquids. All the others are solids and not volatile in the ordinary sense of the term, though some of them may, with certain precautions, be partially sublimed. Nearly all of them are colourless, and may be obtained in a crystalline condition. All of them are odourless, and most of them have a more or less bitter taste. Some of them appear to exist uncombined in the plants, but most of them are combined with acids, chiefly organic.

Formerly it was customary to include among alkaloids all basic bodies, whether derived from plants or from animals. At present the term is usually restricted to those which naturally occur only in plants, or which have, at least, been first obtained from plants. The term "artificial alkaloid" is sometimes applied to secondary alkaloids derived from natural ones —for instance, to bodies like apomorphine, homatropine, or hydrastinine. The term "synthetic alkaloid" may be applied and should be restricted to alkaloids which occur in nature, but have been prepared synthetically. It should never be applied to basic bodies only obtained synthetically and not occurring in nature at all (such as kairine, thalline, antipyrine, etc.).

Alkaloids are distributed very irregularly through the vegetable kingdom. Some of the natural orders are quite rich in alkaloids (for instance, the *Papaveraceæ*, *Rubiaceæ*, *Solanaceæ*, etc.), while others contain only a few or contain none at all. The latter appears to be the case with the *Gramineæ*, *Labiatæ*, and *Compositæ*. Nearly all plants which contain alkaloids are dicotyledonous. Of the monocotyledonous plants only the *Liliaceæ* appear to contain any (*Colchicum*, *Asagræa*, *Veratrum*). In acotyledonous plants they are very rare. Among the cryptogams alkaloids are found only in some of the fungi (muscarine) and club mosses (lycopodine); none at all occur in the seaweeds, lichens, mosses, and liverworts.

A few alkaloids occur in more than one natural order (caffeine, berberine). Most of the other alkaloids are peculiar to certain natural orders or members thereof. Very often there is more than one alkaloid in one or the same family or member. In some cases a large number occur side by side.

The distribution of alkaloids through the several parts of a plant varies. Most of them occur in the parts latest in growth or having the most active circulation—that is, in the fruit and seeds, the roots, or leaves—but also in the bark, being formed in the cambium layer, and then stored in the dead bark.

The following alkaloids are those which have been or are now more or less used therapeutically:

Aconitine (crystalline), from *Aconitum Napellus* L.
Alstonine, from *Alstonia scholaris* R. Br.
Aspidospermine, from *Aspidosperma Quebracho-blanco* Schlechtendal.
Atropine, from *Atropa Belladonna* L. and *Datura Stramonium* L.
Bebeerine, from *Nectandra Rodiæi* Schomb.
Berberine, from *Berberis vulgaris* L., *Hydrastis canadensis* L., and many other plants.
Brucine, from various species of *Strychnos*.
Caffeine (a feeble alkaloid forming unstable salts with acids), from coffee, tea, and guarana.
Carpaine, from *Carica Papaya* L.
Cinchonidine, Cinchonine, } from certain species of *Cinchona*.
Cocaine, from *Erythroxylon Coca* Lamarck.
Codeine, from opium.
Coniine, from *Conium maculatum* L.
Cornutine (composition undetermined), from ergot.
Curarine, from curare.
Daturine, from *Datura Stramonium* L. According to Ladenburg, this is a variable mixture of atropine and hyoscyamine.
Duboisine, from *Duboisia myoporoides* R. Br. According to Ladenburg, this is identical with hyoscyamine.
Emetine, from *Cephaelis Ipecacuanha* (Brotero) A. Richard.
Ergotinine (composition undetermined), from ergot.
Erythrophlœine, from *Erythrophlœum guineense* Don.
Eserine, same as physostigmine.
Hydrastine, from *Hydrastis canadensis* L.
Hyoscine, from *Hyoscyamus niger* L.
Hyoscyamine, from *Hyoscyamus niger* L., *Atropa Belladonna* L., *Datura Stramonium* L., and *Duboisia myoporoides* R. Br.
Morphine, Narceine, Narcotine, Papaverine, } from opium.
Pelletierine (or punicine), from *Punica Granatum* L.
Physostigmine (or eserine), from *Physostigma venenosum* Balfour.
Pilocarpine, from several species of *Pilocarpus*.
Quinidine, Quinine, } from various species of *Cinchona*.
Sanguinarine, from *Sanguinaria canadensis* L.
Scopolamine, from *Scopolia atropoides* Schult.
Sparteine, from *Cytisus Scoparius* (L.) Link.
Strychnine, from various species of *Strychnos*.
Theine, same as caffeine.
Theobromine, from *Theobroma Cacao* L.
Tropacocaine, from a Javanese coca.
Veratrine, from *Asagræa officinalis* (Schl. et Ch.) Lindley. This is not a single alkaloid, but a mixture of several.

VI. *Organic Acids.*—Bodies having an acid character, forming salts with bases. The principal organic acids which come under consideration here are the following: Acetic, agaric (instead of "agaric acid," it is more usual to employ the term *agaricin;* the substance is extracted from white agaric), benzoic, butyric, camphoric, citric, ergotinic (composition undetermined), gallic, lactic, malic, meconic, oleic, oxalic, salicylic, succinic, and tartaric (tannic acid is classed under "Tannins").

VII. *Colouring Matters.*—A class of bodies of very varying properties, the nature of many

of which is not yet understood. Many of them will eventually find their proper place under other group heads.

VIII.—*Resins.*—Resins, in the sense of proximate principles, do not comprise the ordinary commercial resins, such as shellac, damar, ammoniac, etc., all of which are complex bodies, but the term is intended to apply to the several chemical individuals of a resinous character which exist in nature. Resin of jalap, resin of podophyllum (often called podophyllin), resin of scammony, etc., are also complex bodies and not proximate principles.

IX. *Fixed Oils and Fats.*—These bodies properly do not belong among the proximate principles, because they are not simple bodies, but compounds of the radicle glyceryl (C_3H_5) with various fatty acids, or rather their anhydrides. When fixed oils or fats are decomposed by suitable means, the glyceryl separates, combines with some of the elements of water, and forms glycerin ($C_3H_5(OH)_3$), while the fatty anhydride takes up the hydrogen left over from the decomposed water and produces the corresponding fatty acid. Glycerin, therefore, is not a proximate principle, strictly speaking, because it does not exist as such in these bodies. When obtained by any process whatever it is rather a *product* than an *educt.* It is, however, customary and convenient, when making a proximate analysis of a vegetable or animal substance, to report among the constituents "fixed oil" or "fat," if any has been found, because it is easy to isolate it in this form and to subject it to tests of identity.

There is no sharp distinction between fixed oils and fats, so far as their physical character is concerned, their consistence (fluid or solid condition) at the ordinary temperature depending upon their melting point, and this again upon the melting point of the fatty acid which they chiefly represent.

X. *Waxes.*—These are likewise compound bodies, closely allied to fats, but containing no glyceryl. For convenience sake they are usually classed among "proximate principles."

XI. *Volatile Oils.*—A large group of bodies, mostly liquid at ordinary temperatures, with more or less odour, volatilizable with the vapour of boiling water, and usually extracted from plants in this manner. A few volatile oils, when thus extracted, are found to consist of only one constituent; but most of them are more or less complex bodies, which may be separated from each other by suitable means. If the single constituents can be separated from the oil without altering their nature, they must be regarded as the true proximate principles. For instance, by fractional distillation, safrol, a definite chemical individual, may be separated from oil of sassafras or from oil of camphor. Safrol, therefore, is a proximate principle, and it happens to be an active principle also (see under XIII). Oil of sweet birch (*oleum betulæ*, U. S. P.), on the other hand —which, by the way, constitutes the largest proportion of the commercial oil of wintergreen—consists entirely of methyl salicylate, a compound body, which, when split up by appropriate agents, is converted into methylic alcohol and salicylic acid. Strictly speaking, even these are not its proximate principles, since they do not exist as free methylic alcohol and as free salicylic acid in the oil. When making a proximate analysis of a plant it is usual to report the "volatile oil" among its constituents, as if it were a proximate principle.

The commonest constituents of volatile oils are terpenes (hydrocarbons) of the composition $C_{10}H_{16}$. Some volatile oils consist entirely of terpenes. Others contain, besides, some oxygenated compounds. When exposed to cold, certain volatile oils separate into a solid portion, calted stearopten, and a liquid portion, elæopten. Besides terpenes, some volatile oils contain phenols, ketones, aldehydes, compound ethers or esters, etc., which are preferably put together in a group by themselves.

XII. *Camphors.*—These are volatile aromatic bodies, solid at the ordinary temperature and closely related to the volatile oils, although they are, unlike many of the latter, homogeneous individuals. It is customary in works on materia medica to make the term camphor embrace the stearoptens obtained from many essential oils, irrespective of their true chemical character. The only active principle properly belonging here is the official camphor from *Cinnamomum Camphora* (L.) Nees et Eberm.

XIII. *Miscellaneous Compounds.*—Since it is now known that many organic chemicals, not referable to the other groups here mentioned, occur as proximate principles in plants and animals, it seems best to place these all in one group, the single members of which may again be arranged in proper sections or sub-classes —for instance, phenols, ketones, etc. For our purposes it will be sufficient to establish the group at large, since the number of active principles belonging to it is not numerous. The following may be mentioned:

Anethol (the essential constituent of oil of anise).

Carvol (the essential constituent of oil of caraway).

Eucalyptol, or cineol, existing in the essential oils obtained from a variety of plants.

Eugenol (the main constituent of oil of cloves, and also occurring in other oils).

Guaiacol (the essential constituent of creosote from wood-tar).

Menthol (the essential constituent of oil of peppermint; sometimes called peppermint-camphor).

Safrol (obtained from oil of sassafras, or from oil of camphor).

Thymol (from oil of thyme, and several other oils; sometimes called thyme-camphor).

Apiol (not the green liquid extract commonly sold, but the colourless crystalline substance extracted from oil of parsley).

XIV. *Protein Bodies.*—These constitute a class of substances otherwise known as albuminoids, all containing nitrogen, and chiefly valuable as food.

XV. *Ferments.*—The true ferment substances, either vegetable or animal, have not as yet been isolated. Their presence is known only by their effects. They are contained in certain preparations sold in the market in a

more or less concentrated form. From vegetable sources: papayotin (from the milk sap of *Carica Papaya* L.). From animal sources: pepsin, pancreatin (composed of trypsin, amylopsin, steapsin, and a ferment which coagulates milk).

The Employment of Active Principles in Place of the Corresponding Crude Drugs.—Whenever it is known that the characteristic physiological and therapeutic effects of a plant are wholly represented by the active principle which it contains, and when the latter is readily obtainable, it is self-evident that the employment of the latter—a definite, homogeneous, readily identifiable body—will eliminate from the treatment of a case many of the factors of uncertainty which would be connected with the use of the drug itself, or with that of one of its common Galenical preparations, such as a tincture, fluid extract, etc., since these are loaded with inert matter. There can be no doubt that pilocarpine, for instance, can fully replace jaborandi; emetine, ipecac; physostigmine, Calabar bean; sparteine, scoparius; pelletierine, pomegranate bark; and a suitable mixture of strychnine and brucine (about equal parts), nux vomica or ignatia; but this list could not be very much further extended at the present time. So far as cinchona is concerned, its principal alkaloid (quinine), and even some of the other alkaloids, can fully replace it so far as the treatment of intermittent fever is concerned. But cinchona contains small quantities of other constituents which appear to come into useful play when it is used as a simple tonic. Cocaine has certain decided effects and special uses. The drug it is derived from—coca leaves—possesses some valuable properties not referable to cocaine, though it is not yet clearly known to what they are due. None of the single constituents of opium fully represents it. In fact, most of them differ in their action more or less from each other; and even an artificial mixture made up of the known constituents of opium in about their original proportion does not fully equal the effects of opium itself. None of the principles so far isolated from digitalis, nor any mixture of them, can fully replace the drug itself. These facts should be borne in mind to prevent disappointment when the results expected from the use of an active principle are not realized. At the present time it is necessary to study each active principle by itself, and to remember its peculiar effects if they differ from that of the drug from which it is derived.—CHARLES RICE.

ADANSONIA.—The bark of the baobab tree of Africa, the largest tree known, used as a febrifuge. An infusion of 1 oz. in 20 oz. of water may be taken in the course of a day.

ADEPS.—See FAT, LARD, and LANOLIN.

ADJUVANTS are remedies or measures employed for the purpose of intensifying or furthering the action of drugs, etc., but which by themselves have a somewhat different physiological effect. For example, perfect quiet is an adjuvant to anodynes, calomel and capsicum to quinine in malarial troubles, etc. The list might be extended indefinitely, but as the term is so nearly self-explanatory it is hardly necessary. [The *adjuvant elixir* of the Nat. Form., intended chiefly as a vehicle for acrid or distasteful drugs, is a syrup of sweet-orange peel, wild cherry bark, Russian licorice, coriander seed, and caraway seed.]—R. H. NEVINS.

ADONIDIN.—The active principle of *Adonis vernalis* (see ADONIS).

ADONIS.—A ranunculaceous plant related to the genus *Anemone*, that grows wild in Europe, Asia, and Africa. The species that have been employed in medicine are *A. vernalis*, *A. capensis* (seu *vesicatoria*), and *A. cupaniana*. These seem to possess similar characteristics. When fresh, the plant has acrid, irritant, caustic, and vesicating properties that disappear when it is dried. In Europe and Africa the bruised leaves of the fresh plant have been popularly used as a substitute for cantharides. Parkinson attributed to adonis lithontriptic properties.

Pallas states that in Siberia *A. vernalis* is used as an *abortifacient*, and that in Russia it has been used as a household remedy for cardiac and renal dropsy.

A. N. Bubnow reported in 1879 that an infusion of from ⅔ to 2 drachms of *A. vernalis* in 6 oz. of water possessed an action resembling that of digitalis, and that in some instances this drug had quieted the heart when digitalis had failed to do so. He made physiological experiments with an aqueous extract injected into the lymph sac of frogs, in doses varying from ¼ of a drop to 6 drops, and found that it caused, proportionally to its dose, most energetic ventricular contractions, that eventually diminished, the ventricle remaining in systole for some seconds; the venous sinus and auricles distended and attempted to act, ineffectually, until a few drops of blood penetrated into the ventricle, when it contracted spasmodically anew. In 1882 V. Cervello isolated from a precipitate produced by tannin a glucoside, adonidin. Adonidin is a clear, yellow powder that has a bitter taste; it is insoluble in ether or chloroform, but is soluble in water and in alcohol. It is obtained from the leaves, rhizomes, and roots of *A. vernalis* or *A. cupaniana*, 10,000 parts of the plant furnishing about 2 parts of the glucoside.

Huchard and Traversa found that the principal action of the infusion and of adonidin was on the cardio-vascular apparatus, regulating and slowing the cardiac beats, increasing the apical shock, and diminishing the heart's dimensions. There were increased urinary excretion, disappearance of dropsy or œdema, slowing and deepening of the respiration, and diminution of palpitation and dyspnœa. Both Huchard and Hare found that the increased arterial pressure was due to stimulation of the vaso-motor centres and to the increased cardiac force. In toxic doses it paralyzes the peripheral extremities of the vagus, excites the accelerator system, and eventually produces paralysis of the cardio-motor nerves.

Huchard recommended an infusion of 4 to 8 parts of the plant in 200 of water, to be taken three or four times a day. He administered

the alcoholic tincture in doses of from ½ to 1¼ drachm. Adonidin may be given in doses of from $\frac{1}{20}$ to ⅓ of a grain, repeated two or three times a day if necessary. In large doses Huchard found that it caused vomiting or diarrhœa.

Either the infusion or the glucoside is useful in cases of *uncompensated heart disease* in which, in consequence of arrhythmia and insufficiency of the cardiac energy, grave circulatory disorders exist. The drug has a marked diuretic action, in consequence of increased arterial pressure. With the diminution of œdema in dropsical patients there are decreased body weight and greater comfort.

Da Costa and Albertoni advise its administration in *palpitation* independent of cardiac lesion.

H. C. Wood considers that it acts more promptly than digitalis, and, as it may be administered for months without any cumulative effect resulting, it is to be preferred to digitalis in those cases of *mitral* or *aortic regurgitation* in which the latter drug is not well tolerated. Where the drug is to be administered for a long time the use of the glucoside is preferable to that of the infusion.

Samuel T. Armstrong.

ADRUE.—See Cyperus articulatus.

ÆGLE MARMELOS.—See Bela fruit.

AEROTHERAPEUTICS.—See Air, Compressed or Rarefied.

AEROZOL.—A mixture of essential oils, chiefly oil of spruce, said to contain 25 per cent. of ozone by volume, to which is attributed any therapeutic value it may possess.

ÆRUGO.—Verdigris, impure copper subacetate (see under Copper).

ÆSCULIN.—A glucoside found in the bark of the horse chestnut (*Æsculus Hippocastanum*). It has been recommended as a substitute for quinine, and antiseptic properties have been attributed to it.

ÆTHER.—See Ether.

ÆTHER ANÆSTHETICUS. — Aran's ether, a varying mixture of numerous chlorethers, formerly used as an *anæsthetic.* Its action is similar to that of chloroform, over which it has no advantages, while its great tendency to undergo changes on keeping renders it untrustworthy.

ÆTHER CHLOROFORMIATUS.—A mixture of 1 part of chloroform and 9 parts of ether, recommended by Weigel as an *anæsthetic.*

ÆTHEROLEA.—Those of the elæosaccharа of which an ethereal oil is a constituent.

AFFUSION.—Much confusion exists in the employment of the terms affusion and douche. To such an extent has this gone that the term affusion is now rarely employed, all methods and procedures by which water is forcibly projected against the body being described as *douches.* Strictly speaking, however, such a use of the word douche is incorrect, as including too much. Though in affusion nothing is requisite save that the liquid shall fall upon the body from a height, and the water may be cold, tepid, or hot, yet tepid affusions are rarely employed, and hot ones usually only in rapid alternation with cold ones, to promote absorption of old inflammatory deposits, and to excite nerve action in hysterical conditions.

Cold affusions (40° to 60° F.) are practically, then, both generally more useful and in more general use than any other forms. In *fever* Currie's method may find useful employment, but rather as a nerve tonic and exciter in asthenic conditions than for its antipyretic value. Even in this condition it is now seldom employed, and in the Brand method of cold bathing we find a more efficient and convenient means of meeting the indications. In one febrile condition, however, cold affusion is invaluable—namely, in *insolation*, or sunstroke. The patient suffering from sunstroke should be stripped of all his clothing and laid upon a table; he should be vigorously rubbed with ice, and from a watering pot or sprinkler held at a height of about six feet above his body ice water should be continuously let fall upon him. These procedures should be persisted in until the patient's rectal temperature has fallen to 101°; they are then to be discontinued, lest the fall of temperature which continues after the withdrawal of these means become too great, and collapse be thereby induced. In the greater number of cases these procedures are all that are required, even the necessity for stimulation generally not appearing, since the decidedly stimulant effect of cold water dropping forcibly and in fine streams upon the surface of the patient's body excites all the vital functions to activity, and renders the use of other therapeutic measures unnecessary. Should the temperature subsequently rise considerably, as is not infrequently the case, the application is to be repeated. The beneficial effect of the cold affusion used in cases of insolation is truly wonderful, the circulation becoming more natural, the respiration growing deep, convulsions and delirium ceasing, the temperature falling rapidly, coma disappearing, and the mind becoming clear. No other therapeutic procedure can in any way compare with this in the treatment of sunstroke, a fact that has again and again been demonstrated in the hospital services of large cities.

In non-febrile conditions, too, the cold affusion is a useful application, but it is by no means to be used indiscriminately. If following its administration the respirations become deep, the pulse grows full and strong, the skin gets red and glowing, and the extremities are rendered warm—in short, if vigorous reaction takes place—then has affusion been wisely used. If, on the other hand, its employment results in pallor of the surface, cyanosis of the extremities, weakening of the circulation, and all the symptoms of depression, then is it by no means to be repeated, lest it work serious harm. From these facts, then, we may infer that the use of the cold affusion will usually be unwise in the very young, the aged, those whose vitality from any cause is notably lowered, and those suffering from organic disease of the heart or blood-vessels.

In *coma*, *asphyxia*, *syncope*, and *narcotism* cold affusion is often of great service, acting most vigorously to arouse and to restore the patient.

In *frost bite* it is frequently useful, restoring the circulation in the affected part.

In *chorea* and allied spasmodic diseases the use of the cold affusion will in some cases serve to determine a healthier action in the disturbed nerves.

As a refreshing and tonic agent in conditions of slight loss of vigour, as from overwork or overstudy, it is often of value.

In *hysterical manifestations* the brief application of the cold affusion (or the cold douche) outranks all other therapeutic applications.

To promote the absorption of *chronic inflammatory thickenings and deposits* (especially if rheumatic) cold affusions will often be of benefit, but it must be admitted that the rapid alternation of hot and cold water applications, as in the Scotch douche, is generally more effective.

As a corrector of functional disturbances in any part of the body when due to defective innervation, the cold affusion or the cold douche is one of the most valuable curative agents in our possession.

The action of the cold affusion, then, is seen to depend in febrile conditions partly upon its antipyretic action, but in all conditions its greatest value lies in its great power to excite, stimulate, and restore defective and impaired innervation not dependent upon organic disease. When the nervous condition is such that its application is followed by healthy reaction, its use is invariably for good; but when depression is its result, it is not only of no curative value, but most potent for harm.

In applying the affusion, especially if the force is great, the stream large, or the temperature low, care must be exercised in directing it upon the head, the chest, or the abdomen. It is, therefore, wiser as well as more beneficial to allow the water to fall finely divided, as from the sprinkler, rather than in mass, as from a wide-mouthed vessel or a pipe. It is, moreover, better not to exceed either a fall of six feet or a temperature lower than 40° F. To quote the opinion of Bartholow, "no greater height than ten feet, and a column not larger than four inches, will be proper or safe under any circumstances."—HENRY A. GRIFFIN.

AGARIC.—Under the name agaric three varieties of fungus have been used in medicine.

Agaricus albus, purging agaric, *Polyporus officinalis*, *Boletus laricis*, the *agaric blanc* of the Fr. Cod., is a fungus growing upon the European larch. Prepared for the market, it presents the appearance of yellow or white masses of a friable and spongy character. Its odour is heavy and sweetish, and its taste at first sweet, then acrid and nauseating. It was formerly used to some extent as a purgative, and for this purpose was given in doses of 10 grains. In this use it had nothing of value to recommend it, and it had the serious disadvantage of frequently causing nausea.

In doses of 5 grains it has been much used, particularly in the southern parts of the United States, for the prevention of abnormal sweating, especially the *night-sweating* of phthisis. Nausea frequently follows this dose also, and occasionally diarrhœa.

Agaric as such is now little employed medicinally, though its active principle, *agaricin*, is in general use.

Agaricin (agaric or agaricinic acid), $C_{16}H_{30}O_6+H_2O$, is a white crystalline powder of slight solubility in water. It is extracted from *Agaricus albus* by the action of alcohol.

Agaricin is mainly used to prevent the *sweating of phthisis* and exhausting diseases, and thus employed is often of great value. For this purpose it is given in doses of from $\frac{1}{12}$ to $\frac{1}{2}$ a grain, usually in pill. It is exceedingly slow in its action, as much as from six to ten hours being required for the production of its full effect. Nausea and diarrhœa at times follow its administration, but may be prevented by combining it with a little opium, preferably in the form of Dover's powder.

Though it is occasionally given hypodermically in doses of from $\frac{1}{12}$ to $\frac{1}{6}$ of a grain, its use thus is not to be recommended, owing to its irritating nature and its tendency to cause suppuration.

Agaricin is occasionally used to diminish bronchial secretion, and sometimes to stop the flow of milk.

Its effect in diminishing secretion is believed to depend upon its action on the terminal nerve fibres in the glands.

Agaricus chirurgorum, *Boletus igniarius*, *Polyporus fomentarius*, touchwood, tinder, spunk, punk, the *agaric de chêne* of the Fr. Cod., is a fungus growing upon the oak.

Touchwood is a tough, porous, and spongy material which finds some application in surgery. Thus, its physical characters render it a hæmostatic of some value. In hæmorrhage of small amount, as from leech bites, agaric bound over the wound is often most efficient, and it has been highly recommended for use in plugging the nose for the relief of *epistaxis*.

From its characteristic of burning slowly when ignited, touchwood was formerly in common use as a moxa, and to render it more inflammable it was often soaked in a solution of nitrate or of chlorate of potassium. Moxas having become practically obsolete, its use for this purpose is now very uncommon.

HENRY A. GRIFFIN.

AGARICUS MUSCARIUS.—See MUSCARINE.

AGATHIN.—This proprietary preparation is a compound allied to antipyrine. Chemically it is salicylaldehyde-α-methylphenylhydrazone. It is in the form of white scales, odourless and tasteless, insoluble in water, soluble in alcohol or ether. It was recently much vaunted as an analgetic, especially in *neuralgia* and *rheumatism*, for which purpose it was given in doses of from 4 to 8 grains three times a day, but it does not seem to offer any great advantage over the better-known analgetics.

AGGLUTINANTS are applications which serve to approximate and retain in position lacerated or incised tissues. Formerly a large number of substances were held in high repute for this purpose, but now the term is restricted to adhesive and court plasters, collodion, and all adhesive substances used in the dressing of wounds.—R. H. NEVINS.

AGRIMONY, the herb of *Agrimonia Eupatoria*, the *aigremoine* of the Fr. Cod., was formerly much used as an astringent and tonic, but it is now little used except for the preparation of domestic mouth washes and lotions. Internally the dose is from 1 to 2 drachms.

AGROPYRUM REPENS.—See TRITICUM REPENS.

AILANTUS.—The bark and leaves of *A. glandulosa*, *A. excelsa*, and *A. malabarica*, the tree of heaven, Chinese sumach, simarubaceous trees indigenous to India and China. It is chiefly used as an *anthelminthic*, especially against *tapeworm*, and is reputed less depressing than pomegranate. The dose of the bark or leaves is 8 grains, and that of a non-official fluid extract is from 15 to 30 grains.

AIR, CONDENSED OR RAREFIED.—The density of air is measured by its pressure, or, to state the same fact in other words, *air exerts in every direction a pressure proportional to its density.* Upon this fact, together with the general physical laws that *motion takes place in the direction of least resistance*, and that *action and reaction are equal and opposite*, is based that portion of the art of pneumotherapy that deals with air modified in density.*

In discussing this subject it is necessary not only to bear in mind the general physiology of respiration and circulation and the facts and laws of the mutual relations of these processes, but also to remember that the respiratory and circulatory mechanisms are commonly adjusted to the prevailing atmospheric pressure. The external surface of an ordinary human body being about sixteen square feet, the atmosphere presses thereon with a weight of about sixteen tons, which would "crush us to earth" were it not counterbalanced by an equal pressure acting upon the interior. Thus when the pressure of the air upon a part of the exterior is partially removed, as in cupping, that part is seen to be immediately forced outward, the motion being shared by both solids and fluids; but, the latter moving more readily than the former, a congestion of the part with blood is evident.

Important modifications of physiological and pathological processes may therefore be brought about by modifying the pressure of the atmosphere upon the body in general, or upon a portion of the body, or differently upon different portions of the body. Such modifications of pressure are the mechanical effect of natural or artificial alterations in the density of the atmosphere.

While for purposes of exact research an exact standard, taking account of corrections for temperature and moisture, is necessary, we may for practical purposes assume the ordinary mean barometric pressure at sea level, of 30 inches (760 millimetres) of mercury, representing about 15 pounds to the square inch (1·033 kilogramme to the square centimetre) as that of an unaltered or *standard atmosphere.* Natural variations—that is to say, the ordinary barometric fluctuations—within a range of 2 inches of mercury may be disregarded. When, however, the mean barometric pressure at any locality in the temperate zones is constantly less than 28 inches of mercury, that locality must be considered to fall within the category of those having *naturally rarefied atmospheres.* Naturally rarefied atmospheres exist at stations elevated above sea level, the pressure diminishing about 1 inch of mercury ($\frac{1}{2}$ pound to the square inch) for every 1,000 feet of elevation. From 2,000 to 3,000 feet is termed *moderate altitude*, 4,000 to 5,000 feet *high altitude*, more than 5,000 feet *great altitude.* The volume of a stated quantity of any gas being inversely as the pressure, in rarefied atmospheres the weight of the oxygen contained in a given volume of air is much diminished. Thus, at the sea level, 1 cubic foot of dry air at 32° F. (0° C.) contains 130·4 grains of oxygen, while at an elevation of 5,000 feet the oxygen is reduced to 108·6 grains. In condensed atmospheres the oxygen is proportionately increased; at a pressure of $1\frac{1}{2}$ atmosphere 1 cubic foot of dry air at 32° F. contains 195·6 grains of oxygen.

Artificially modified atmospheres may be *condensed*—that is, of increased or *positive pressure;* or *rarefied*—that is, of diminished or *negative pressure.*

Such modifications may be made to affect both and equally the *respired air* and the *surrounding atmosphere*, or one of these factors only, or both unequally. The former method, that in which the patient breathes air of the same (modified) density as that wherein he is immersed, is termed the method of *absolute pressure*, or the method of Tabarie. It embraces the *condensed-air bath* and the *rarefied-air bath.* The latter group of modifications, those in which the patient breathes air differing in density from that wherein he is immersed, are included under the method of *differential pressure*, otherwise termed *respiratory differentiation*, or *pneumatic differentiation*, or the method of Hauke and Waldenburg. This method embraces a number of expedients (8) tabulated in the further course of this article.

It is evident that, in so far as diminution of atmospheric pressure is concerned, the physiological and therapeutical effects of sojourn at altitudes are to be considered under the head of *absolute pressure.*

Historically, however, it was not the observation of the robust health and great thoracic development of mountaineers, or of the improvement in health of invalids, and especially of *poitrinaires*, upon removal from lowlands to mountains, that led to the use of artificially modified atmospheres in therapeutics; and

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* For therapeutical purposes air may be modified not only in respect to its density, but likewise in respect to temperature, moisture, or chemical composition.

the artificial reproduction of the atmospheric pressure conditions of altitudes—that is to say, the *rarefied-air bath* (or *absolute negative pressure*)—has not as yet been found of much importance. Paradoxical as it may seem, it is the *condensed*-air bath (or *absolute positive pressure*) that, intermittently used at low levels, best imitates the therapeutic effects of altitude; and it was in fact through studies of the effects of condensed air upon vegetable and animal life, together with observations of the results upon men of descent in diving bells and into deep mines, that this important, but as yet imperfectly appreciated, addition to the resources of medicine was made.*

Tabarie made a communication upon the subject to the Parisian Academy of Sciences in 1832,† and in 1853 Junod reported to the same body the results of his own experiments upon man. The first practical applications of the method in the treatment of disease seem to have been made in 1838, under the direction of Tabarie, by Pravaz and others. Tabarie's apparatus, upon the principle of which most subsequent ones have been modelled, consisted of a wrought-iron spheroidal chamber, large enough to accommodate a dozen persons, into which the external air was forced by a steam pump, and from which the air respired by patients was removed, the rate of efflux being made sufficiently less than the rate of afflux to secure any desired elevation of pressure within the chamber. *Pneumatic chambers* of variously modified construction have been erected and are in operation at many resorts on the Continent of Europe.‡ There is one at the Brompton Hospital, London, but the writer knows of none in America. At each medical centre, however, there should be such a chamber (or a number of such chambers), under the care of an experienced physician, for the use of patients referred by their medical attendants, the latter retaining proper control or oversight of the details of treatment in consultation with the specially expert physician in charge.#

Absolute-Pressure Method.‖—Without entering into mechanical details, the general features of a *pneumatic chamber* may be described. The purpose of the apparatus is to immerse the patient for a certain time in air of greater (or less) density than that to the action of which he is ordinarily exposed. The change of pressure must be brought about gradually, after the patient has entered the chamber; and after a certain length of exposure to the modified atmosphere the ordinary pressure must be gradually restored before the patient emerges. The apparatus consists, therefore, of two essential parts: an air-tight chamber (usually of iron—in one instance, at least, of stone), and a pump or other mechanism by which air is forced into, or removed from, the chamber. The chamber consists of a properly lighted and tastefully furnished room in which a patient or several patients may be seated, and a vestibule, or antechamber, in which changes of pressure may be effected independently of the pressure in the main or respiration chamber. The object of this latter provision is to afford a means of exit or entrance to the physician or attendant without disturbing the pressure in the respiration chamber, and without subjecting the person entering or leaving to too sudden a change. Some chambers have a sort of double window by means of which books and other small articles may be passed in or out without disturbing the pressure. Electric bells and other means of calling instant attention are likewise provided. In addition there must be suitable devices for the removal of carbon dioxide and other products of respiration, and for the regulation of the temperature and the humidity of the air of the chamber. Provision can also be made for modifying the proportions of oxygen, nitrogen, or carbon dioxide, or for the impregnation of the incoming air or of the air of the chamber in any proportion desired with any gas, vapour, or volatile medicament, or any drug susceptible of nebulization. The various desiderata have been well accomplished by the chamber erected at Reichenhall by G. von Liebig. It is figured in Yeo's translation of Oertel's *Respiratory Therapeutics*: London, Smith Elder & Co., 1885.

It consists of three rooms of sheet iron, arranged somewhat on the plan of a *trefoil* and communicating by means of an antechamber, the whole being inclosed by an outer iron wall with a door through which entrance is gained into the antechamber. The three other walls of the antechamber are formed by the walls of the three respiration chambers. Each room contains three windows of thick glass, and is 2·33 metres high and 2·04 metres in diameter. Its base is thus 3·267 square metres, and its capacity 7·612 cubic metres. Three persons can sit around a table in each of the chambers, and altogether nine persons can be accommodated in the apparatus. The antechamber has an average width of 1 metre and a depth of 1·3 metre, and is a little lower than the respiration chambers. Air is forced in by a pump which stands in another room and is operated by a steam engine. The air enters the antechamber on each side of the door, through two iron tubes, each 7 centimetres in diameter and 29 metres in length. To these tubes regulating cocks are attached. The wooden floor of the antechamber and the carpeted floors of two of the main chambers are perforated, and there is an orifice in the floor under the wall separating each of these main chambers from the antechamber. The air from the antechamber entering the chambers through these perforations, the patient does not feel the shock of the pumping and the elevation is regulated more equably. Air escapes from the chambers

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* *Vide* J. Solis-Cohen: *Inhalation; its Therapeutics and Practice*, 2d ed., Philadelphia, 1876, p. 37.

† *Comptes, rendus* t. vi, p. 896.

‡ For a description of the different forms of pneumatic chambers, see Oertel, *Handbuch der respiratorischen Therapie*, Leipzig, 1882; English translation, by Yeo, London, 1885.

\# There is at Brussels such an establishment, which owes its existence to the gratitude of a wealthy resident of that city who recovered his health under pneumatic treatment at Montpellier.

‖ With this the writer has had no detailed personal experience, and he relies principally upon the writings of von Vivenot, Oertel, and Hovent.

through orifices in the walls near the ceiling, closed by gratings, to which outlet pipes furnished with regulating cocks are attached. A mercury manometer with millimetre divisions for determining the air pressure in the chamber is placed outside near the door in communication with the antechamber, while within, near the window of the respiration chamber, an Augnst's psychrometer shows the temperature and amount of moisture. The double-action air pump yields with every lift 27·3 metres of air and the piston makes about 140 excursions in the minute. An overplus of air, therefore, constantly streams into the chambers, and a uniform regulation is brought about by an assistant who stands in the antechamber and observes the manometer and the psychrometer.

The pressure is increased not by arresting the efflux, but by increasing the afflux of air, in this way giving satisfactory ventilation. The pressure in the third chamber may be made lower than that of the other chambers by means of a stopcock cutting off a part of the air from entrance by way of a pipe leading from the antechamber. The temperature is regulated by cooling or warming the instreaming air as it passes through the feeding pipes.

At Brussels a different plan is adopted. By means of a specially constructed pump the same air is kept circulating through the respiration chamber and a series of pipes communicating with immense wash bottles, some containing alkaline solutions and others containing pure water, in order to remove the carbonic acid and other products of respiration. A gas engine furnishes the power.

Other forms of apparatus have been devised not materially differing in essential principles from those described. In some, rarefaction of the air of the chamber can be effected by reversing the action of the pump. The doors must be specially adjusted.

Management of the Apparatus.—An experienced attendant familiar with the construction and the physical principles of the apparatus must always be at hand to observe and to regulate, according to the directions of the physician, the conditions of pressure, temperature, moisture, etc. The physician in charge of the institution should always be within easy call. The preferable pressure varies with the individual case and with the nature of the disease for which the patient comes under treatment.* As a rule, an excess pressure of $\frac{2}{5}$ to $\frac{3}{7}$ of an atmosphere (equal to 30 to 32·5 centimetres—12 to $12\frac{3}{4}$ inches—mercury) gives the best results. With weak patients, however, it is not safe to exceed $\frac{1}{5}$ of an atmosphere (15·2 centimetres—6 inches—of mercury)—at all events until the patient has become habituated to the treatment and has shown signs of marked improvement. Very weak persons, especially those with febrile temperatures and much depressed in general condition by chronic exhausting disease, should not be subjected to pneumatic treatment. It could only hasten the end. Symptoms of fever in young and strong persons suffering with acute catarrhal inflammations of the respiratory tract are not, however, considered to contra-indicate pneumatic treatment. The transition from ordinary pressure to an excess pressure previously determined should occupy, as a rule, about thirty minutes. When the excess pressure has reached the intended limit, it must be maintained unchanged for about an hour (or, in exceptional cases, two hours). and half an hour should again be consumed in gradual transition to the barometric figure. It has been given as a general rule that each transition period should occupy one minute for every centimetre of mercury measuring the increase of pressure, and that the period of unchanged pressure should be two minutes for each centimetre of mercury of excess pressure.

Acute forms of disease, hyperæmias, and catarrhal inflammations usually require a shorter period of treatment than chronic cases. In the beginning of treatment the sittings should occur daily. After some weeks every two or three days may be sufficient. Some physicians make more or less prolonged intermissions between successive series of daily sittings. Apart from recovery or improvement, the indications for ceasing pneumatic treatment or for intermitting it for a long time are the signs of excessive organic combustion—that is, fever, emaciation, excessive hunger (sometimes followed by complete loss of appetite), marked lassitude, and muscular weakness.

The physiological and therapeutical effects of the methods of the pneumatic chambers can be best studied after we have considered those of the

Differential Pressure Method.—The cost of pneumatic chambers, their restriction to certain resorts, and their inapplicability or inefficiency in certain particulars have led to many endeavours to construct portable apparatus for pneumotherapy. The first practical apparatus for *inhalation of condensed air* was made by Hauke, of Vienna, in 1870; and the same observer likewise devised a *pneumatic cuirass* and a *pneumatic tub*, by which the air about the chest or that about the entire body of the patient could be rarefied while the ordinary atmosphere was breathed. Hauke's apparatus has, however, only an historical interest, having been superseded by that of Waldenburg and others. Waldenburg's apparatus is simply a gasometer in which air is compressed or rarefied by means of weights, and from which or into which the patient breathes. There are various scales, gauges, and other attachments for purposes of exact observation. The air, taken from a proper source and filtered on its way to the gasometer, is conveyed to the patient by means of a rubber tube, and prevented from escaping by means of a mask of spun metal or of rubber edged with pneumatic rubber cushions, which is placed over the nose and mouth and correctly adjusted to the face. A two-way

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* Pressures are usually described in fractions of an atmosphere, and it must be remembered that the figures given are to be added to or subtracted from the standard atmospheric pressure. Thus, when an excess pressure of $\frac{1}{2}$ atmosphere is mentioned, it means an absolute pressure of $1\frac{1}{2}$ atmosphere, or 22·5 pounds to the square inch; a negative pressure of $\frac{1}{5}$ atmosphere means an absolute pressure of $\frac{4}{5}$ atmosphere, i. e., 12 pounds to the square inch.

stopcock of hard rubber, or a metallic arrangement modelled on the cornet-piston placed between the supply tube and the mask, regulates the ingress and egress of air. The same apparatus may be used for both inspiration from and expiration into condensed or rarefied air, but it is best to have two cylinders for expiration, so that the air inhaled may run no risk of contamination. Weil and others have combined the two cylinders in one apparatus, and variously modified the details of construction. (See Oertel, *op. cit.*). Fraenkel has constructed an apparatus like an accordion, Biedert a large reversible bellows, Geigel and Mayr a water-engine bellows, Mathieu and others various forms of apparatus utilizing hydrostatic principles. The writer's apparatus (Fig. 1), described in 1884, is designed to furnish an instrument as simple, but more cleanly. manageable, and reliable than Fraenkel's or Biedert's, and at the same time less cumbersome and expensive than Waldenburg's or Geigel and Mayr's, and thus capable of being used by the patient at home. A further advantage that it offers over all instruments except that of Geigel and Mayr is its continuous action. As now improved, it consists of a small gasometer of zinc, the air chamber of which is 8 inches in diameter and 24 inches high, and a foot bellows such as is used by dentists. (For office use a pump. and for hospital work a special form of reservoir and pump with steam or electric motor, is substituted. See *N. Y. Med. Jour.*, Feb. 23, 1889.) Filtered air from out of doors is conveyed to the bellows through a tube attached to a window board, and pressure is made by weights placed upon the air chamber. A second cylinder with suspended weights may be used for rarefied air, and a second bellows may be so combined with the first that one stroke of the foot operates both. (For details see *N. Y. Med. Jour.*, Nov. 23, 1889). A further improvement contemplates a great reduction in size by surrounding one air chamber by another, instead of using two gasometers. In the physician's office and in hospitals the double apparatus is desirable; in the patient's residence the single cylinder for condensed air is usually sufficient. With all these forms of apparatus various attachments for medicating, warming, cooling, moistening. or drying the air can be utilized.

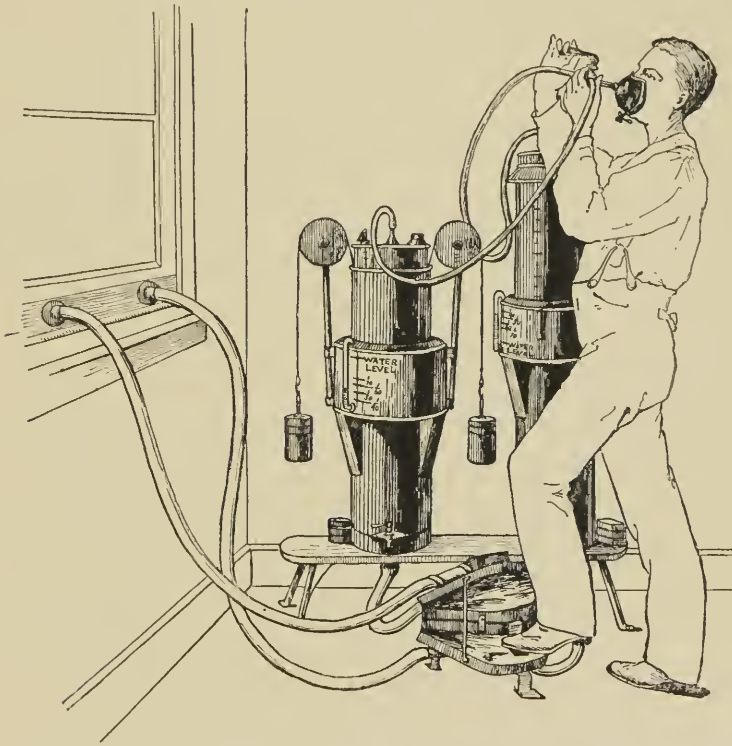


FIG. 1.—The author's apparatus for inspiration of condensed air and expiration into rarefied air.

Williams and Ketcham have devised an apparatus termed a "pneumatic cabinet." It is an air-tight metal chamber, just large enough to allow one patient to be comfortably seated therein; containing a glass window, through which the patient can be observed, and having an hermetically closing door. By means of a bellows attached to the instrument the air within it can be slightly condensed or rarefied, and a tube leading to the outer air is furnished

with a mouthpiece through which the patient inhales and exhales. The inspired air can be medicated or otherwise modified. The degree of pressure is shown by a mercury manometer. While theoretically this instrument may be used in various ways, in practice the air about the patient is usually rarefied by about $\frac{1}{30}$ atmosphere, and he thus inspires from and expires into relatively condensed air. Its effects will therefore be considered under the head of *Continuous respiration of condensed air* (see page 25). It is at once much more expensive and considerably inferior in range of usefulness to the other forms of apparatus described.

For special purposes a number of handy or pocket instruments have been described. Dobell has devised an apparatus called a *residual air pump.* It consists of a mouthpiece with a valvular arrangement which allows freedom of expiration, but partially impedes inspiration, the nostrils being closed or unused during the process. It is intended for use in the treatment of emphysema.

The writer has devised an apparatus which he has termed "*the pneumatic resistance valves.*" It consists of a pair of small hollow, bipartite, metal cylinders (1 in. × 2 in.), each containing an ebonite valve, the movement of which is resisted by a spiral spring, the tension of the spring being regulated by turning

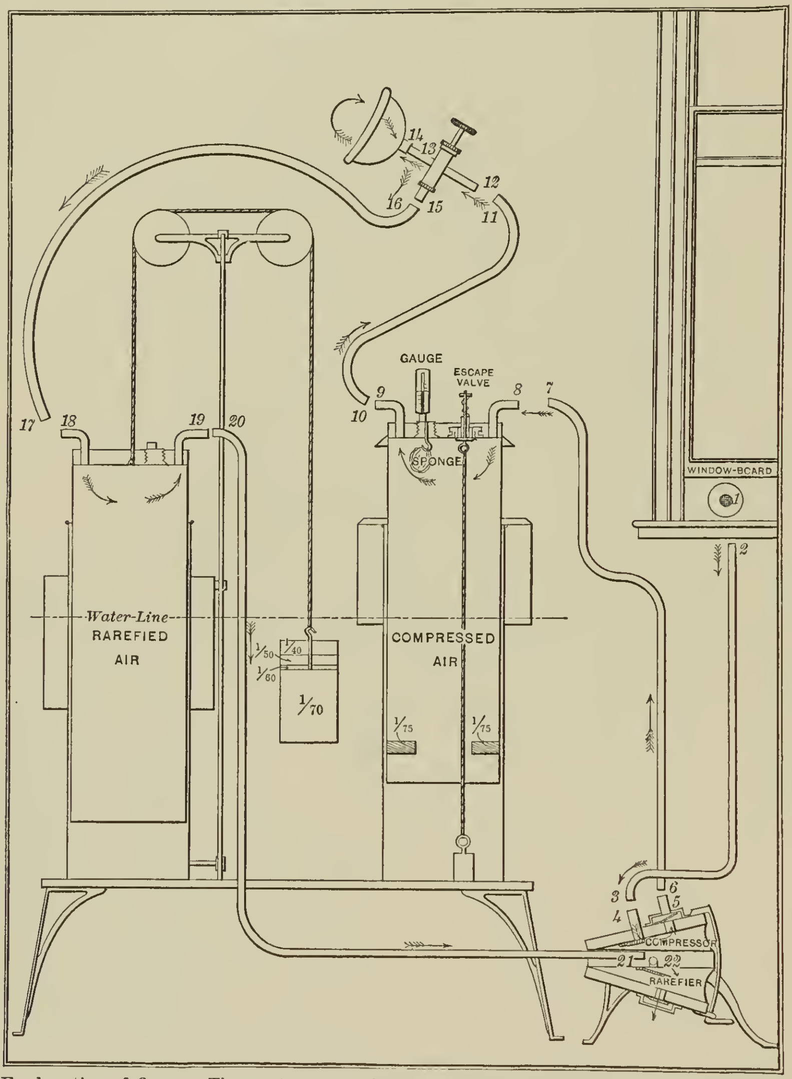


FIG. 2.—Explanation of figure. The parts are numbered in order of attachment, and in the direction of air-current; from the window to the mask through the compressed-air gasometer: and from the mask to the discharge pipe of the rarefying bellows through the rarefied-air gasometer. The discharge-pipe may also be connected with window if desired. The direction of air-current is indicated by the arrows.

the perforated cap of the cylinder. Beneath the cylinders, and communicating with them through the valve seats, runs a metallic tube open at both extremities and attached at one extremity to a rubber tube, terminating in a hard-rubber mouthpiece. The patient inhales and exhales through the apparatus, occluding the anterior opening of the air tube during the phase of respiration to be affected. The respiratory current is then forced to pass through the cylinder. One valve is so arranged as to impede the inspiratory current, the other to impede the expiratory current. Thus are obtained the effects of inspiration from rarefied air, and of expiration into condensed air. The instrument is intended to be used as a means of regulated pulmonary gymnastics. A scale of fractions of an atmosphere engraved upon the cylinder shows the degree of positive or negative pressure needed to overcome the resistance of the valve. In place of a spring, weights may be used to regulate the pressure. In such a case, a square opening of $\frac{1}{4}$-inch side will be most convenient. A sponge or cotton wad, on which a few drops of a volatile medicament are placed, may be inserted in the path of the incoming air.

The cylinders can be used separately or together, or either may be used in connection with a gasometer apparatus by inserting it into the proper part of the stopcock.

Changes of intrathoracic air pressure can of course be obtained without any apparatus whatever. Thus if, while nostrils and mouth are closed, forced expansion of the chest is made (Müller's experiment), the air within the lungs will be rarefied; or if after a full inspiration the glottis or the mouth and nostrils are closed and an effort is made to contract the chest (Valsalva's experiment), assisted perhaps by manual compression of the chest (Weber's experiment), or of the chest and abdomen (Gerhardt's experiment), the intrapulmonary air will be condensed. A less degree of condensation may be caused by exhaling through but partially closed lips or by interrupting the expiration following a prolonged inspiration by slowly counting aloud (phonic expiration). It is obvious, however, that the effect of rarefaction can thus be produced only during a prolongation of the inspiratory phase of the respiratory act, while compression can be brought about only by a baffled or impeded expiration. The respiratory rhythm is completely deranged, the mechanical force developed and employed remains an unknown and variable quantity, and the disturbance of circulation is usually out of all proportion to the therapeutic value of the expedients.

Method of employing the Portable Apparatus.—Atmospheric pressure upon the exterior surface of the body remaining unchanged, increase of pressure upon the surface of the air passages (pulmonary surface) may be obtained, first, by inspiration of condensed air; second, by expiration into condensed air. Decrease of pressure upon the pulmonary surface may be obtained, first, by inspiration of rarefied air; second, by expiration into rarefied air. These procedures may be so combined as to maintain the increase or decrease during both phases of the respiratory act, or to allow of increase during one phase and decrease during the other. There are thus eight methods of respiratory differentiation, which may be tabulated as follows:

Inspiration of	*With expiration into*
1. Condensed air	Atmosphere.
2. Condensed air	Condensed air.
3. Condensed air	Rarefied air.
4. Rarefied air	Atmosphere.
5. Rarefied air	Rarefied air.
6. Rarefied air	Condensed air.
7. Atmosphere	Condensed air.
8. Atmosphere	Rarefied air.

To carry out all these eight methods, two of Waldenburg's gasometers, or the writer's double gasometer and a pair of resistance valves, will suffice.

The procedures numbered 1 and 3 are the most generally applicable. For the former a single gasometer of Waldenburg's or the writer's apparatus, for the latter a double gasometer is required. That numbered 2 is physically the equivalent of the method of the pneumatic cabinet of Williams. It is, in the writer's experience, of but limited applicability and inferior to the other methods. It requires two of Waldenburg's gasometers or one of the writer's gasometers and an expiration resistance valve. The procedures numbered respectively 4, 6, and 7 can be carried out with no other apparatus than the resistance valves. The procedure numbered 5 would require two cylinders of Waldenburg's or the writer's expiration gasometer, and an inspiration valve. It is of only theoretical importance. Procedure No. 8 requires a single cylinder of Waldenburg's or the writer's expiration gasometer.

The excess or negative pressures employed in the differential methods are much smaller than in the pneumatic chambers, varying from $\frac{1}{75}$ to $\frac{1}{30}$ of an atmosphere. In negative pressure (rarefaction) $\frac{1}{40}$ atmosphere is rarely to be exceeded. In expiration into condensed air or against the resistance valve $\frac{1}{50}$ atmosphere should not be exceeded except with great caution. It is always wise to begin with the minimum pressure and increase as the patient's susceptibility is learned and his progress indicates. Patients use the apparatus at first for five minutes, later for thirty minutes at a time, and from one to four times a day. If weak they may be seated, but it is better to stand. All constricting garments should be loosened. Inspiration should be as slow, expiration as prolonged as possible, the patient being encouraged to increase the volume of air inhaled or exhaled at each respiration, as shown by the scale of cubic contents upon the air cylinder. The treatment should not be pushed to the point of fatigue. A rest of ten minutes before and after treatment, and sometimes an interruption and rest of five or ten minutes during treatment, are advisable. The time thus consumed is a great drawback when the treatment must be carried out at the physician's office. For this reason it is preferable in cases of chronic disease, like pulmonary tuberculosis or

asthma, to have the patient purchase (or rent from the instrument maker) some form of apparatus that can be used at home after due instruction has been given. The home apparatus has also the advantages of cheapness and of applicability to cases of patients confined to the house or prevented by bad weather, distance, or other causes from visiting the physician's office.

The physical effects of respiratory differentiation must be considered with reference, first, to respiration; second, to circulation. Motion of air and of blood takes place from the point of high pressure toward the point of low pressure. Increased pressure upon the pulmonary surface, therefore, favors the entrance of air into the chest and the expansion of the lungs, and opposes the exit of air from the chest and the contraction of the lungs; thus it facilitates inspiration and impedes expiration. It tends to drive the blood out of the heart, out of the thorax, and toward the periphery. Decreased pressure upon the pulmonary surface facilitates expiration and impedes inspiration. It tends to drive the blood from the periphery toward the thorax and into the right heart.

PHYSIOLOGICAL AND THERAPEUTICAL ACTION.

Inspiration of Condensed Air.—The excess pressure employed varies from $\frac{1}{80}$ to $\frac{1}{30}$ of an atmosphere (+ 9·5 to + 25 *mm.* Hg.). From 10 to 150 respirations may be made continuously, and the process repeated after a rest of 5 or 10 minutes. The patient, if able, should stand, with head erect and shoulders thrown well back. If necessary, the physician should aid inspiration by pressing the shoulders backward or assist expiration by compressing the chest. When it is desired to localize or locally increase the effect, the other portion of the chest may be strapped or its motion diminished by manual pressure or a suitable pad and brace.

Respiration.—The muscular effort of inspiration is diminished and the alveoli are dilated to a greater extent than would be possible from unaided voluntary effort. There is increase in the quantity and in the penetrating power of the inspired air, therefore reopening of air cells disused from weakness or occluded by swelling of the bronchi, by pathological secretion, etc. There is increase in the volume, and in the weight per volume, of oxygen brought to and absorbed by the blood, a much greater area of blood surface being reached. The subsequent expiration is sometimes slightly retarded, though theoretically it should be easier in all cases. It is deeper than usual, the quantity of air expelled and of carbon dioxide eliminated being increased. Tidal and complemental air are thus augmented, reserve air diminished, the first two quantities and a portion of the third quantity being added to form what is now virtually an increased volume of tidal air, reaching 200 cubic inches or more. Diminished frequency of respiration, increased expansion, ventilation, and gaseous exchange are therefore the immediate effects; increased vital capacity the ultimate and permanent result. In some cases the increase of chest measure is remarkable. It is not due to a pathological emphysema, as expiration can be perfectly performed.

Circulation.—During inspiration there is an augmented centrifugal tendency of the blood current. The ventricular systole is increased in force. Both arterial and pulmonic circulation are at first quickened, bringing more blood, therefore more corpuscles, more hæmoglobin, in proportion to area, in contact with the increased quantity of inspired oxygen. The systemic vessels are filled, causing a rise of arterial blood pressure. The pulse becomes at first more rapid, afterward slower, full, and hard. The blood circulates more actively throughout the body, penetrating more readily into capillaries and lymph spaces, and being richer not only in oxygen but also in nutritive materials; for pressure upon the diaphragm transmitted to the abdominal viscera stimulates absorption of chyle, while heightened pressure and augmented quantity of blood in the viscera tend to stimulate functional activity. The waste products of metabolism are more thoroughly removed. Thus, increased oxidation and tissue change increase appetite and improve nutrition; the increased alimentation is utilized; there is better combustion and elimination.

The effect upon pathological conditions is due partly to the general effect upon respiration, circulation, and nutrition, and partly to local mechanical pressure. When pulmonary hyperæmia exists it is relieved. The absorption of inflammatory products is hastened. The general tone of the bronchial mucous membrane and the pulmonary tissue is heightened. Cough and expectoration are at first increased from dislodgment of accumulated materials, afterward diminished from relief to irritation and diminution of pathological secretions. Increased ingestion and assimilation repair pathological waste, and the increase in weight sometimes exceeds the previous record in good health. Toxic metabolins, whether autogenetic or heterogenetic, are destroyed and removed; useful metabolins are again formed. Thus fever is diminished, sleep is promoted, night sweating is often arrested, and hæmoptysis is sometimes checked.

Expiration into condensed air impedes the act and requires greater muscular exertion. If this be sufficient to overcome the obstruction, the amount of air expelled is increased. Otherwise it becomes gradually diminished, and the subsequent inspirations are therefore rendered shallower. In other words, tidal air is at first increased, but soon diminished; residual air gradually encroaches upon reserve air, tidal air, and finally upon complemental air, the entire volume becoming practically stationary or residual. The excursions of the diaphragm and thoracic walls become less and less, but at the expense of the contraction, fixed expansion being finally maintained, and if the procedure be pushed to excess with too high a pressure, apnœa may result. Pulmonary ventilation is diminished and gaseous exchange is retarded, the absorption of oxygen by the hæmoglobin being, however, facilitated, although the excretion of carbon dioxide is diminished. The

effect upon *the circulation* produced during expiration is less relieved by subsequent inspiration than in the converse case, and is thus an exaggeration of that described as the effect of inspiration of condensed air, being practically the same as in Valsalva's experiment—depletion of the lungs and heart, overdistention of the systemic vessels, especially the veins. The pulse may disappear from compression of the subclavian artery. Upon pathological conditions, the pressure effects are similar to those already detailed.

Continuous respiration of condensed air, therefore, greatly augments the distention of the thorax and of the lungs, maintaining the patency of the alveoli; and while it diminishes during treatment the volume of air exhaled, the result may nevertheless be properly stated as an increase in vital capacity. The ventilation of the lungs is diminished, but, on the whole, gaseous exchange appears to be slightly increased. There is constantly increasing interference with the dilatation of the heart, and an outward pressure replaces the normal thoracic aspiration of the blood, thus blocking the systemic veins, while at the same time the arteries are distended. Arterial tension, increased at first, soon falls, and the pulse becomes small, slow, and feeble.

Inspiration of rarefied air, which should be conducted against a very small negative pressure, rarely exceeding $\frac{1}{60}$ of an atmosphere, increases the muscular effort necessary to produce expansion of the chest, and the volume of air needed to supply the proper weight of oxygen. If the requisite effort can be made, there is increase in the elastic tension of the lungs and in the volume of tidal air. If it can not be made, there is decrease in both these factors. The subsequent contraction of the chest is at first passively facilitated, afterward impeded, from the resistance of the denser outer air. The muscular effort of this phase is thus also increased, and the frequency of respiration, at first heightened by the excitement of impediment, is finally diminished. Ventilation and gaseous exchange are, on the whole, increased, vital capacity is augmented, and the muscles of inspiration are strengthened. The blood tends at first to leave the periphery and accumulate within the thorax; but as there is more blood delivered to the left ventricle, and this can contract with sufficient force to overcome the higher peripheral pressure, the final result is a quickening of the circulation with an increase in the blood pressure and tension of the arteries.

Expiration into rarefied air, conducted with a negative pressure of from $\frac{1}{60}$ to $\frac{1}{20}$ of an atmosphere, facilitates the contraction of the thorax, exerting a moderate suction force, and greatly increasing the amount of air expelled from the lungs, thus facilitating the collapse of distended air vesicles. Subsequent inspirations are rendered easier and deeper, more oxygen-bearing air enters the vesicles, ventilation and gaseous exchange are enormously increased, and the gain in vital capacity is very great. The circulatory effects are similar to those produced by inspiration of rarefied air, but more marked. They vary in different individuals, are evidently different in man and animals, and can be influenced by the manner of subsequent inspiration. While there are conflicting observations as to systemic blood pressure, there is agreement as to the tendency to pulmonary congestion and the facilitation of cardiac diastole.

Inspiration of condensed air, with expiration into rarefied air, therefore increases the efficiency of both processes. The alternate expansion and contraction of the lung tissue stimulates its elasticity. Pulmonary ventilation, both as to interchange of gases and expulsion of effete materials, is vastly augmented. The alternations of opposing circulatory effects relieve hyperæmia wherever present, increase the activity and penetrating power of the blood current, and stimulate tissue change and nutrition.

Inspiration of rarefied air, with expiration into condensed air, increases the muscular effort necessary to complete each act, prolongs the respiration, and retards expiration particularly. The alternation of centripetal and centrifugal impetus increases the activity of circulation.

Inspiration of rarefied air, with expiration into the same medium (continuous respiration of rarefied air), increases the muscular effort of inspiration, but hastens and facilitates expiration. The centripetal tendency of the blood is maintained during the entire act, and the heart's action is greatly diminished in force and increased in frequency, the general arterial pressure being much lowered.

The effects of differential pressure being kept in mind, return may be made to the study of the method of absolute pressure.

Physiological Effects of the Method of Absolute Pressure.—In this we deal not only with much greater pressures than in the differential method, but with more complicated physical and physiological conditions. Some of these space permits us only to allude to. In a complete study there should be considered not alone the effects of pressure upon the various organs and their functions, but also the chemico-biological action of the air itself, a gas much richer in weight of oxygen (and other constituents) per volume, and otherwise physically altered. Furthermore, the pressure effects have three distinct stages: 1, the stage of gradually increasing (or diminishing) pressure; 2, the stage of maintained pressure; 3, the stage of gradual restoration to standard pressure. In the first and third stages, therefore, are manifested certain differential effects, reversed in order and nature.

Condensed Air.—On entering the chamber, the patient's lungs, bronchi, windpipe, larynx, pharynx, nasal passages, and Eustachian tubes contain air, and the stomach and intestines contain gases of the standard pressure. Not only will time be required to secure equalization, but, as the pressure constantly ascends, new occasion for equalization is continually made. To the sensations of the patient this is especially manifested in relation with the ear, the tympanic membrane being at first

pressed inward with the accompaniment of ringing noises, pain, and a sense of fulness and occlusion. Toward the end of the sitting, in the period of gradual return to standard atmospheric density, the pressure conditions are reversed and the drumhead is now pressed outward, the sensations being like those first experienced, but less in degree.

When catarrhal swellings or other obstructions exist they are much increased, and in some instances pain will forbid the employment of full pressure, or alternate increase and diminution will be necessary. Usually, however, adjustment occurs spontaneously or may be brought about by repeated motions of deglutition, or by Valsalva's experiment, or even by catheterism, if necessary. Normal hearing power is diminished in the pneumatic chamber, but deaf persons hear better in condensed air than under ordinary conditions. The senses of touch, taste, and smell are obtunded. Articulation is impeded. The voice is raised in pitch and acquires a metallic clang.

Respiration and Circulation.—The cutaneous surface and the parts immediately underlying the lungs and upper air passages are at once influenced by the first increase of atmospheric density, and the effect becomes greater as the pressure rises. The blood is forced from the surface of the body; the lungs are expanded, and partially exsanguinated. In the deeper structures the effect takes place more slowly and only under steadily increasing compression of the overlying parts. Equalization occurs more readily, but more gradually, and the process will continue until there has been complete transfer of pressure from cell to cell, alike of soft and hard parts and fluids. The effects are therefore not limited to the duration of the disturbing influence, but will continue after the patient has emerged from the pneumatic chamber.

The intestinal gases, being slowly expelled, are condensed under the pressure exerted upon the abdominal superficies and from above by the diaphragm and expanded lung. Space will thus be given for pulmonary expansion.

As the exchange of air between the lungs and the atmosphere takes place less rapidly than the increase of pressure of the air within the chamber, the air in the lungs remains always of a less density than that of the external air. This difference of pressure permits the external air to find its way more readily into the minutest ramification of the pulmonary air tubes. After prolonged action of increasing pressure there will be a gradual equalization between the pressure upon various portions of the body and between that of the air and gases contained within the cavities of the body and that of the external atmosphere. The organism will then accommodate itself to the pressure acting uniformly upon all its parts, and the effects will be constant. The lungs will therefore no longer expand beyond normal limits, pressure upon the thorax and within the lungs being now the same.

As, however, the heart and vessels are diminished in calibre and the diaphragm is depressed into the abdominal cavity, slight expansion of lung tissue in the neighbourhood of these structures may take place. Thus, if the pressure continues to act steadily, enlargement of the total pulmonary volume not being possible, compression of the tissue of the lung itself must take place, proportioned to the degree of condensation of the air and the resistance of the various components of the pulmonary parenchyma and intrathoracic structures in general, the most compressible being the elastic fibres, vessels, nerves, and glands. The lumen of the air vesicles is thus enlarged, and the lung contains a greater volume of air of greater density, but in nearly the same total space as normal.

If the vessels are congested, they are thus emptied, and circulation is facilitated while metabolism is stimulated by the compression exerted upon the cells and fluids of glands, lymph spaces, and connective tissue. Pressure upon the heart, the aorta, the pulmonary arteries, both venæ cavæ, and the lymphatics causes a stimulation of absorption and outflow, diminution and increasing consistence of their contents. Pressure upon these structures is always less than upon the lung, and while the circulation continues in both directions the tendency of fluids is increasingly from the lungs into the heart and thoracic vessels, and from these as well as from the external surface into the vessels of the deeper parts. Motion, however, must take place along the ramifications of the arterio-capillary-venous canal, and in the general direction of its normal currents. Thus there is increased absorption and circulation through the lymphatic, venous, and arterial channels other than those of the lungs and the skin.

As pressure is gradually lowered till it reaches the normal standard of the atmosphere, a reverse process of equalization takes place. The surface of the body, the skin, and the lungs are again the first affected. Their vessels expand, the blood and lymph are invited thither from the deeper parts; the intestinal gases increase in volume; the diaphragm recedes into the chest; the air passes from the alveoli into the bronchi, finally into the outer air; the compressed tissues of the lungs expand gradually and resume their normal volume; the heart and thoracic vessels again fill with blood, but under conditions more favourable to function than those in existence before the sitting.

But as the intrapulmonary pressure will for some time remain greater than the external pressure the danger of rupture of the vessels from too sudden re-expansion will be avoided.

To summarize: *In the condensed-air bath* inspiration becomes easier, expiration more laborious; the respirations are increased in depth and diminished in frequency; the mobility of the thorax and the elasticity of the lung tissue are increased. These effects continuing after the sitting, the ultimate result is a great gain in vital capacity. The dilatation of the heart is antagonized, but to a less degree than its contractions are aided. Relative blood pressure is lowered, so that the pulse becomes smaller

and slower, and the blood tends from the superficies, pulmonary and general, to the deeper parts and to those vessels contained in cavities with firm and unyielding walls. There are increased absorption of oxygen and increased tissue change, therefore increased nutrition and increased excretion. Upon the nervous system the effects are sedative and soporific. Concerning pathological conditions, cutaneous and pulmonary, it may be noted that hyperæmia is opposed and resorption of effusions and inflammatory new formations favoured by mechanical compression, as well as by the increased oscillations of lymphatic and venous circulation and by the stimulation of absorbents and emunctories.

Rarefied Air.—As the rarefied-air bath is not as yet employed to any extent in therapeutics, it would be of merely theoretical interest to describe its physiological effects. In practice the effects of a rarefied atmosphere are usually secured by sending the patient to a mountain resort. Here, however, other factors likewise come into play, and the subject is therefore more appropriately discussed under CLIMATIC TREATMENT. The atmospheric influence of altitude depends partly upon diminution of pressure, partly upon the coldness and dryness of the air, and partly upon its lessened amount of oxygen. The patient is forced to expand his lungs more fully to appease the *besoin de respirer*, and this expansion, as well as the subsequent expiration, is more readily effected. Thus result great and permanent gains in vital capacity, as shown by remarkable increase in thoracic expansion. Pathological, especially catarrhal and infiltrative, processes are often checked and disused areas of lung cells are brought into active function. The blood tends more readily to the surface of the skin and respiratory mucous membrane, and the heart beats more rapidly and is forced to harder labor. Thus at first unpleasant respiratory and circulatory symptoms are experienced, even to epistaxis and hæmoptysis in the healthy. These soon pass off, however, as the organism adjusts itself to the changed conditions, and the vigour and tone of the heart and vessels are increased. Hæmatosis and general nutritive processes are stimulated, excretion is more complete, and there is a buoyancy of spirits of no mean value in treatment. Persons with weak hearts, of neurotic temperament, or advanced in years, can not bear more than moderate altitudes, and even these are contra-indicated in febrile cases, or in the presence of ulcerative processes in the larynx or bronchi. The principal benefit of the rarefied air of altitude is in the prophylaxis against pulmonary tuberculosis in young predisposed subjects, and in the treatment of the early stages of pulmonary tuberculosis in patients not presenting the contra-indications mentioned.

THERAPEUTICS.—The practice of pneumotherapy closely follows physiological lines. The degree of usefulness of pneumatic expedients in any given instance will of course vary with the conditions of the case, and proper hygienic, dietetic, and medicinal measures must also be instituted. There are also important

Contra-indications. — Persons over fifty years of age should not be subjected to the condensed (or rarefied) air bath or sojourn at altitudes of over 2,000 feet. Beyond this, the conditions forbidding pneumatic treatment by either method are much the same, but apply with greater force to the absolute than to the differential procedures, and to high pressures than to low pressures. They are, in brief: Great weakness; exhaustion by long-continued disease; continuous high temperature (101° F. or over); marked hectic; active inflammation; pulmonary softening in progress; advanced bronchiectasis; the presence in the bronchi or pulmonary cavities of large quantities of septic products that might be absorbed; extensive excavation in one or both lungs, sufficient to give rise to danger of rupture, or of hæmorrhage, or of generalization of infection; general tuberculosis; atheromatous degeneration of vessels; severe hæmorrhoids or a marked hæmorrhagic tendency of any kind; the apoplectic habitus; inflammations and congestions of the brain, spinal cord, alimentary canal, kidneys, ovaries, or uterus; cardiac weakness of marked degree, and especially degenerative myocarditis.

In addition, the effects specially recommending certain expedients in certain affections equally contra-indicate these expedients in affections of an opposite pathology.

Therapy of the Absolute Method. — The range of usefulness of the condensed-air bath is limited, but within its range the procedure is effective. Its action in diminishing *hyperæmia of the cutaneous and respiratory surface* is utilized in the cure of chronic congestive and inflammatory conditions of these structures. In addition, it is employed with good effect in the treatment of *catarrhal deafness*, in *subacute nasal, laryngeal, pharyngeal*, and *bronchial catarrhs*, and even in acute cases when not attended by high fever. It is said to cure *whooping-cough* in three or four weeks and to keep the patients fairly comfortable during the progress of the disease. In *pulmonary emphysema* unaccompanied by cardiac lesion it often affords great relief, as likewise in *bronchial asthma*. In the latter affection it is alleged by some to be curative, and it is certainly a method of treatment superior to the use of any drug. It is also of advantage in promoting the absorption of *pleuritic effusions* and in *convalescence after pleurisy and pneumonia* when the lung is slow to re-expand and resume normal function. It is a prophylactic measure of great value against *pulmonary tuberculosis*. In the various catarrhal and other affections of the bronchi and lungs preceding or associated with pulmonary tuberculosis it is one of the most potent agents for cure. In the early stage of pulmonary tuberculosis (stage of consolidation) it is frequently curative. It sometimes assists recovery from phthisis even after softening and excavation have occurred, and is of benefit in all stages short of the last, when the conditions already noted as contra-indica-

tions are present. Some observers commend it in certain cardiac lesions; others prohibit it in all. In the absence of personal experience, the writer can simply express a theoretical leaning toward the more cautious view. In *anæmas* and in *chlorosis* the condensed-air bath is a decided stimulant to nutrition and hastens the beneficial action of iron or arsenic. In *obesity* it is of great service in promoting oxidation of superfluous fat.

Therapy of Respiratory Differentiation.—An extended personal experience leads the writer to urge with emphasis the necessity for much greater resort to this method of treatment than physicians in general seem inclined to adopt. *Inspiration of condensed air* and *expiration into rarefied air* are the expedients most generally employed, singly or in combination.

Inspiration of condensed air is of benefit in *dyspnœa* of almost any origin; in *laryngeal* and *tracheal stenosis;* in *chronic bronchitis* and *bronchorrhœa;* in *chronic broncho-pneumonitis,* especially in chronic broncho-pneumonitis of the apex (*apical catarrh*) with beginning tuberculosis; in *chronic interstitial pneumonitis;* in *convalescence from croupous* or *catarrhal pneumonia;* in *atelectasis;* in *chronic pleurisy with effusion;* in the *dry pleurisy* of *early tuberculosis* of the lungs; in *chronic pulmonary tuberculosis* of any variety and at any stage short of general softening, with one or more large cavities, but particularly in the early stages, when deficient respiration, impaired circulation, anæmia, and malnutritive dyspepsia in a predisposed subject suggest tuberculosis even in the absence of pronounced physical signs or of bacilli in the sputa.* In these cases it should be recommended in preference to change of climate, except in the case of patients who need not consider expense.

The good results of this procedure in pulmonary tuberculosis can not be too strongly emphasized. They result not alone from the primary effects already alluded to—the opening of disused or occluded air cells, with increased vital capacity, increased pulmonary ventilation, increased activity of circulation, absorption of inflammatory products, relief of congestion—but also secondarily from the increased appetite; relief of cough, with promotion of sleep; and the stimulus to local and general nutrition following the systematic pulmonary gymnastics necessitated. Recovery often takes place even in advanced cases, and in any case suitable for treatment comfort will be increased and life prolonged. In *simple anæmia,* or *chlorosis,* without tuberculous tendency, the same good effects may be obtained. In *asthma* the inspiration of condensed air is also useful, but high pressures are necessary, and must be employed cautiously. In one case—that of a patient who was attacked in the writer's consulting room—the paroxysm was cut short by the employment of a pressure of one thirtieth of an atmosphere, steadily maintained for nearly fifteen seconds, the expiratory act being held for the time in abeyance. This expedient, which probably overcomes spasm by a paralyzing effect upon the bronchial muscles, and by inducing fatigue of the diaphragm, was suggested by the experience of Dr. Monell,* who obtained relief in his own person by forced expiration, with his feet braced against the footboard of his bed, prolonged pause, forced inspiration, pause, and so on. In *asthma* and *emphysema,* however, better results are usually obtainable from expiration into rarefied air. In *hæmoptysis* good results have been reported from the inspiration of condensed air and its equivalent—rarefaction of surrounding air in the Brooklyn pneumatic cabinet. Some authors, however, have considered a hæmorrhagic tendency as a contra-indication to the measure. When there is any weakness of the pulmonary vessels or any peripheral lesion of hæmorrhagic tendency, or where it is inadvisable to increase blood pressure in the brain or in the kidneys † or other abdominal viscera, the measure is undoubtedly dangerous. In two remarkable instances, elsewhere cited,‡ the writer has, however, been forced to credit it with a tendency to the relief of pulmonary hæmorrhage; and this seems to be due directly to the relief of the conditions antecedent to hæmorrhage—namely, *pulmonary congestion*—with perhaps an exaggerated stasis at one spot, from mechanical obstructions affecting that portion of the circulatory apparatus chiefly. Inspiration of condensed air is also recommended in *mitral insufficiency* and in *stenosis and insufficiency of the aortic valves.* It is theoretically indicated in *dilated heart,* and, used with caution, in *lipocardiac asthma.* The writer's experience with it in cardiac lesions is limited, but he has seen apparently good palliative results in a few cases of simple dilatation and of mitral regurgitation of moderate severity, so that he is encouraged to extend its employment in cardiac therapeutics.

Expiration into rarefied air should be combined with the inspirations of condensed air, when it is desired to increase pulmonary ventilation, circulatory activity, and gaseous exchange, or to get rid of obstructing, accumulating, and decomposing matters in the bronchi or alveoli or in quiescent cavities. Thus, the combination is of signal utility in *pulmonary tuberculosis,* in *bronchorrhœa,* and in *chronic pulmonary catarrh.*

Expiration into condensed air should be combined with the inspirations of condensed air when it is desired to relieve congestion or to stimulate absorption, or when increase of vital capacity is the principal object; thus, in *dilated heart,* in *mitral insufficiency,* in *consoli-*

* It may be remarked here that evidences of pulmonary impairment indistinguishable by the ordinary methods of physical exploration of the chest may sometimes be detected during inhalation of condensed air—a fact first published by Dr. J. Solis-Cohen. See *N. Y. Med. Jour.,* October 18, 1884.

* *Med. Record,* August 25, 1866. Cited by J. Solis-Cohen, *op. cit.*

† In one of the writer's cases albuminuria developed during treatment. This may have been merely a coincidence, but at the time it was considered more.

‡ *Phila. Med. Times,* February 6, 1886, p. 362.

dation persisting after pneumonia, in *chronic pleurisy with effusion*, and in the after-treatment of cases in which pleural accumulations, serous or purulent, have been removed by aspiration or incision. Like the method of the pneumatic cabinet of Williams, this combination (continuous respiration of condensed air) is highly recommended by many in the treatment of tuberculosis, for which purpose, however, it is inferior to inspiration of condensed air with expiration into rarefied air. Alternation of the combinations may be necessary in some instances.

Expiration into condensed air is recommended in cases in which expiration is imperfectly performed, as a means of strengthening the respiratory muscles. As practiced with the writer's expiration-resistance valve, it is of use in cases of convalescence from pulmonary tuberculosis and in prophylaxis against the latter affection. In a few early cases with good muscular power, it is of use in the treatment of *pulmonary tuberculosis;* securing better expansion of the lung by back-pressure.

Expiration into rarefied air is of signal advantage in *emphysema* and in *asthma* dependent upon emphysema. It is of some advantage in spasmodic asthma, of less advantage in bronchitic asthma, though of value in all, and in the latter variety may be usefully combined with inspiration of condensed air. Inspiration of *rarefied air* is at times a better combination in emphysema.

Inspiration of rarefied air may also be employed where it is desired to strengthen the muscles of inspiration by increased voluntary exercise, as in cases of contracted thorax, in prophylaxis against pulmonary tuberculosis and in the treatment of the earlier stages, and in convalescence after pleurisy or catarrhal pneumonia. In the latter instances it may be usefully alternated with inspiration of condensed air.

That *forced voluntary respiration*, however useful in suitable cases, can not replace pneumatic treatment, either by the differential or by the absolute method, is evident from the mere statement of the mechanical and physiological effects as well as from the fact that many patients are at first incapable of the necessary muscular exertion. As an adjunct or supplement to treatment by apparatus, or as a means of keeping up the good effects, it often serves excellently.—Solomon Solis-Cohen.

AJOWAN.—See Ammi.

ALANIN.—See Amidopropionic Acid.

ALBUMEN.—The liquid white of hens' eggs, freed from yolk and membranous shreds, the *ovi albumen* of the Br. Ph. Besides its use as an article of food, white of eggs is employed, spread on silk or goldbeater's skin, to make an adhesive plaster that only requires to be moistened when applied: as an antidote to certain corrosive poisons, notably corrosive sublimate and copper sulphate, with which it forms innocuous compounds; and, coagulated by the addition of alum, as an astringent and cooling application in superficial inflammations. Dried white of egg, *albumen ovi siccum, albumen exsiccatum*, is used largely in the arts, but the white of fresh eggs should alone be employed medicinally.

ALBUMINATES.—Albumin (the proximate principle, as distinguished from albumen) forms with certain metals compounds, termed albuminates, which, especially those with iron and with mercury, have been used medicinally in preference to the true salts of those metals, on account of being unirritating and more readily absorbed.

ALCOHOL.—Ordinary alcohol, the alcohol of the pharmacopœias (the *spiritus rectificatus* of the Br. Ph.), is one of a series of hydrocarbonaceous compounds all of which have as their basis a radicle (or fundamental molecule), called *ethyl*, whose molecular structure is expressed symbolically by the formula C_2H_5.

By the addition of an atom each of hydrogen and oxygen, we get the combination C_2H_5HO, or, as it is, perhaps, more commonly written, C_2H_6O. Chemically it is a hydrate of ethyl, or hydrated oxide of ethyl, as some prefer to call it. To distinguish it from others of the group, particularly fusel oil (or amyl alcohol) and wood spirit (methyl alcohol), the common form, of which we are at present writing, is called *ethyl* alcohol.

From the fact of its being obtained by distillation and subsequent rectification or purification from a *mash* of potatoes or grain or from wine lees, it is known in the Br. Ph. as *spiritus rectificatus* or *spiritus vini rectificatus*.

Absolutely pure alcohol, absolute alcohol, the *alcohol ethylicum* of the Br. Ph., does not exist outside the chemical laboratories, as its extraordinary affinity for water is such that it inevitably absorbs some of the latter from the atmosphere. What is known as strong alcohol contains 91 per cent. by weight of pure spirit (U. S. Ph.), and has a specific gravity of 0·820.

The strong alcohol of the British and Prussian pharmacopœias contains more water, their specific gravity being respectively 0·830 and 0·834.

It will be observed that, as alcohol is lighter than water, the specific gravity is always increased by its dilution.

Dilute alcohol contains by weight 45·5 per cent. of pure spirit, with a specific gravity of 0·928 in the United States, while in England and the Continent it is a little stronger.

As the processes of distillation and rectification are given in the dispensatories and various works on practical chemistry, we omit them as of no immediate value to the practicing physician.

Medicinal Applications of Alcohol.—Externally alcohol may be used as a most valuable adjunct in the treatment of *wounds, contusions*, and *sprains*, as well as for inflammatory and other swellings. Its antiseptic influence is very considerable, as it is effectual for this purpose, according to Miquel,* in a 10-per-cent. solution—*e. g.*, in the case of whisky, about 1 part to 4 parts of water. It is also

* Quoted by Sternberg, *Hare's System of Practical Therapeutics*, Philadelphia, Lea Bros. & Co., 1891. p. 595.

of use on account of its hæmostatic properties. When a wound is already infected or, from its nature or cause, presents the liability to infection, or if the question is not free from doubt, then a 50-per-cent. solution, such as is found in ordinary whiskies, may prove to be a very valuable lotion.

This has indeed been used with great success in Scotland by Dr. Blair, in France by Susserot, and by others.* But in the dressing of fresh wounds the weaker solution would be all that would be necessary. In fact, one of the most valuable as well as elegant dressings for wounds and granulating sores, though it is one greatly neglected at the present day, is the aromatic wine of the French Codex (*Kräuterwein* G., *Vinum aromaticum*, U. S. Ph., Fr. Cod.), the *vin aromatique*. This may easily be prepared in any pharmacy, however small. We give the directions copied from the *National Dispensatory* of Stillé and Maisch: "Lavender, 1 part (½ oz. av.); origanum, 1 part (½ oz. av.); sage, 1 part (½ oz. av.); peppermint, 1 part (½ oz. av.); rosemary, 1 part (½ oz. av.); wormwood, 1 part (½ oz. av.); stronger white wine, a sufficient quantity to make 25 oz. av. Mix the solid ingredients and reduce them to a coarse powder. Moisten the powder with 1 oz. of the stronger white wine, pack it moderately in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 25 oz. av., or about 24 fluidounces." As the stronger white wine has 20 to 22 per cent. of alcohol, it will be seen how, in connection with the essential oils of the aromatics, we shall have in this preparation a most valuable dressing. In the absence of the wine, alcohol diluted to one quarter its strength, or whisky to one half its strength, can be substituted for it without detriment to the compound, and in the absence of one or more of the aromatics their places may be filled by the addition of a larger quantity of one of the others. In *snake bites* or the *bites and stings of poisonous insects* alcohol, as strong as possible, combined with ammonia, is an exceedingly valuable, probably the most valuable, lotion to apply after the part has been well sucked and bled (especially in the case of snake bites as well as of all poisoned wounds). Besides its uses as an antiseptic and disinfectant, alcohol is of some value as an astringent, particularly after the opening of cavities containing pus, blood, etc.

[In the *Kansas City Medical Index* for April, 1894, Dr. A. J. Ochsner, of Chicago, reports the most gratifying results from the topical use of strong alcohol in nineteen successive cases of *erysipelas*, after the manner recommended by Behrend. The affected skin, together with the adjacent surface, is scrubbed very vigorously with strong alcohol three or four times a day. The severest cases were cured within five days.]

Alcohol forms one of the best of evaporating lotions when diluted with 8 or 10 parts of water. Its efficacy for this purpose is greatly increased, however, by the addition of vinegar or acetic acid and the chloride of ammonium. A useful formula for the cooling of inflamed parts, such as strained and swollen joints, muscles, and tendons, phlegmons, erythema, erysipelas, and burns of the first degree, is the following:

℞ Ammonii chloridi.......... ʒ ij;
Acidi acet. dil............. ℥ j;
Alcohol.................... ℥ ij;
Aquæ...................... Oj.
M.

By the addition of some perfume—*e. g.*, eau de cologne or the extracts of Lubin and others—a most refreshing lotion may be made for use in *cephalalgia* or for toilet purposes, in the latter case omitting the chloride of ammonium.

The external use of alcohol is also profitable in the case of fever patients. It cools the skin and aids in the removal of those effete substances which are left upon it by the evaporation of the perspiration. With the addition of acetic acid, in about the proportion mentioned above, or of vinegar in three or four times that proportion, it checks, sometimes very remarkably, the colliquative sweating of such patients.

Where it is necessary, however, to thoroughly cleanse the skin, a 10-per-cent. solution of alcohol with the bicarbonate of sodium—a heaping teaspoonful of the latter to half a pint of the solution—is most useful. By this means cleanliness of the skin may often be secured in cases occurring among the ignorant, who have a violent prejudice against ordinary soap and water. A more homely use of alcohol externally is as an agent for the removal of resinous substances and such defilements of the skin as remain after the removal of various plasters.

It is also of practical value in the thorough cleansing of the cuticle necessary to the efficient action of cantharides in many instances. For example, before painting cantharidal collodion on a part, where it is really important that the attempt at vesication should be successful, the preliminary cleansing of the skin with water, alcohol, and soda will be found to be a decided aid. And we may say further that as a preliminary to various hydriatric procedures, especially the various forms of the *pack*, and to fumigations with sulphur, mercury, etc., this thorough removal from the skin of foreign and effete matters which necessarily present a mechanical and sometimes a chemical obstacle to absorption will enhance the efficacy of the treatment. This is particularly true in the case of mercurial fumigations in the advanced stages of syphilis, and points to the great secret of success of treatment at some of the hot springs, where hot baths precede the mercurial or other inunctions.

While thus cleansing and disinfecting the skin, alcohol has the further effect of increasing to some extent the compactness of its structure. Whether this is a permanent change, or only apparent and due to contraction of the unstriped muscular fibres of the derma and of the vascular and other tissues contained in it, would be difficult to say. But it may safely be asserted that it does condense and harden

* *Therapeutics, Mat. Med., and Toxic.*, H. C. Wood, Philadelphia, Lippincott, 1876, p. 124; and numerous other authorities might be quoted.

the epidermic layer, rendering the surface smooth and firm, increasing its resistance to the disintegrating action of friction, and diminishing the sensibility of the nerve terminations. On account of this latter result it makes a very satisfactory application to those parts of the body which are covered by thin, delicate skin with an attenuated cuticle—*e. g.*, the *nipples*, which, when *irritated*, *sensitive to pressure*, *excoriated*, or *fissured*, are wonderfully benefited by the use of diluted alcohol.

Ulcers or *aphthæ of the throat and mouth* are at times much benefited by applications of alcohol, the stronger the better. For this purpose it should be applied as we use the nitrate of silver, nitric acid, chromic acid, etc. A small pledget of cotton is wound on the end of a copper wire or a flexible probe which has previously been *slightly notched* with a knife so that the cotton can not come loose. Or, if the point to be reached is accessible with a straight probe, a small piece of wood, *similarly notched*, will answer the purpose. The cotton is then dipped into the alcohol for not more than one third, perhaps one quarter, of the length of the pledget, leaving the upper two thirds or three fourths dry, in order that the attraction of capillarity may constantly draw the medicament upward, and so prevent any dropping from the free extremity of our probang. The end of the latter, which should correspond as nearly as may be to the size of the ulcer, is then laid upon the sore and held there gently for a few seconds, until coagulation at the surface occurs. If there is much secretion the sore should, of course, as a preliminary measure, be well cleansed and dried with clean absorbent cotton.

Inhalations of alcohol are at times very useful therapeutic aids. It is well known that all the stimulant and narcotic effects of alcohol may be obtained in this way, under favourable influences. In large wholesale spirit warehouses, when it becomes necessary to change quantities of wine or spirits from one kind of receptacle to another, the workers perceive in themselves very decided effects from the alcoholic vapours inhaled while they are at their work. Dr. H. C. Wood affirms that he has induced all the effects of alcoholic intoxication, even to the point of anæsthesia (alcoholic coma), and finally death, experimentally, by simple inhalation of its vapour,* which, of course, was greatly concentrated. Practical advantage may be taken of this fact in the treatment of *shock*, *collapse*, and the *extreme asthenia* accompanying many fevers and toxic conditions, more especially when the condition of the alimentary canal does not admit of the ingestion of sufficient quantities by the mouth, or of its rectal administration. To this purpose the ordinary steam atomizer is well adapted, or use may be made of one of the numerous hand-ball atomizers. But it should not be forgotten in such cases that a 10-per-cent. solution is as strong as can well be borne for any length of time. In the absence of such apparatus the fumes can be generated by pouring alcohol, or some spirit, such as whisky, brandy, rum, or gin, into a vessel partly filled with *hot* water, and allowing the patient to inhale as much of it as possible. This is accomplished by throwing some very light fabric—*e. g.*, a cambric handkerchief—over the vessel and the patient's head, taking care not to exclude the air entirely.

[*Interstitial injections of alcohol* have been used in the palliative treatment of "inoperable" *cancer of the uterus*. In the *Nouvelles archives d'obstétrique et de gynécologie* for October, 1894, Professor Vulliet, of Geneva, makes a favourable report of his experience with this use of alcohol, and alludes to a previous publication on the subject by a German physician. Professor Vulliet employs very strong alcohol, with strict antiseptic precautions. He thinks it acts by causing a local ischæmia.]

The internal administration of alcohol is confined almost entirely to its diluted forms in those beverages long familiar to the human race, excepting the small amounts, comparatively, which are present in tinctures, fluid extracts, and other pharmaceutical preparations. It is, however, the practice, and at times a very useful one, in some hospitals and with some practitioners to make use of the pure alcohol in combination with various bitter tinctures and aromatics. This is done partly to secure accuracy of dosage, partly to avoid the ill effects of the more irritating ingredients of poor or bogus liquors, and often in private practice to avoid collision with the prejudices of the laity. It is also frequently an extremely useful device in dealing with patients in whom there is an unfortunate propensity to the abuse of alcoholic beverages. We have found, for instance, that in the treatment of convalescents two-drachm to half-ounce doses of the tincture of calumba or quassia, re-enforced, if necessary, by the compound tincture of cinchona, have a better tonic effect than the ordinary stimulant beverages, and can be much more safely administered. The dosage is accurate, and may be gradually reduced without leaving any of the unfortunate desire for drink which occasionally, though, we believe, rarely, follows upon the use of stimulants in sickness.

Our discussion of *the constitutional effects of alcohol in health* will be short, and simply designed to direct attention to those points which are of use to the practitioner when called upon to do his duty at the bedside. And, first, we must insist upon the qualitative difference between the effects of small and those of large quantities, as many of the experimental observations of physiologists and pharmacologists have been made with doses much larger than are ordinarily taken, except by inebriates.

The objective results of the ingestion of alcohol are of most importance to the physician, although the subjective effects are not to be ignored here any more than psychical conditions can, in any case, be disregarded by those who are responsible for the welfare of others. The latter, however, are simple, and, though most easily obtained from the testimony of the patient himself, are of such a nature that they reveal themselves to the eye of the practiced observer in so plain a manner that decep-

* *Op. cit.*, p. 114.

tion is not easy. The sensations of warmth, well-being, and comfort following moderate doses are well known. When the amount is somewhat increased, so that the toxic effects begin to be apparent, the character of the sensations experienced by the subject is dependent upon his temperament. The emotional individuality is accentuated, and, a certain amount of anæsthesia preventing or lessening the control of circumstances over the voluntary ideomotor operations, the individual is prone to display what is called his "real character." As a matter of fact, however, he displays one side—the emotional—while the stronger, more rational, controlling, and correlating mechanisms are in abeyance. When the dose is sufficiently large to inhibit that "self-control," so called, which consists in such correlation of ideas and actions as place one in harmony with the environing world, he is no more exhibiting his true character than is a person who is suffering from an attack of acute mania. Neither is he acting "like a beast," for animals conform their actions to their circumstances in such a way as to secure those adjustments which conduce to comfort, the preservation of life, and the propagation of their kind. But the maniac, either from disease or from drink, does none of these things. In the case of the latter the alcohol obtunds the processes of reasoning, and leaves only the lower reflex emotional phenomena. This fact it is important for the physician to bear in mind.

In addition to these subjective or psychical effects, there are others of more importance from a medical point of view. They are, after the exhibition of small or moderate quantities, first, slight quickening of the heart beat, relaxation of the arteries, relaxation of the unstriped muscular fibres of the skin, and a more equable distribution of the blood throughout the body, so that if there has been some chilling of the surface it is again warm; if the extremities were pale and cold, they resume their natural colour and temperature. And this slight surface relaxation favours withdrawal of blood from the muscles and nerve centres when these have been passively somewhat congested by overwork, relieving the sense of fatigue. It is not improbable that a certain tone is given to relaxed arterioles under such circumstances, which also favours the more rapid circulation of blood through the tired organs, the removal of effete matters, and resumption of their normal chemical condition. As this is rest, small or moderate amounts of alcohol properly administered may fairly be said to rest the overtired body. This, however, we regard as a matter not to be proclaimed from the house tops. It should be left to the determination of the physician, and when it is advisable to use alcoholic stimulants for this purpose it is undoubtedly better to prescribe them disguised after some of the methods above given. At all events, *the physician should in all such cases assume the authority of dictating the kind and quantity of stimulant taken, and the doses should be stated and at regular intervals.* By pursuing this plan no medical man need ever incur the responsibility of having made an inebriate of any person, for it will not occur unless in the case of a born dipsomaniac.

In addition to the effects already mentioned, moderate quantities of alcohol tend to increase perspiration, to augment the quantity of urine and of the secretions of the mucous glands throughout the alimentary tract, to improve the appetite where this is deficient, to quicken the special senses, and to overcome relaxation and meteorism of the intestine. These effects are more apparent in subjects in whom the vital actions alluded to are deficient—i. e., in the anæmic, the delicate, the overworked, and those upon whom the cares of life have borne too heavily. In individuals who are predisposed to obesity, or especially plethora, doses which would be salutary in their effect upon others are apt to produce the phenomena of irritation characteristic of the action of larger amounts on the average man. So, too, the peculiarly unstable temperament commonly called the mercurial, which is characterized by rapid changes from emotional exaltation to depression and by an unusual susceptibility to external influences of all kinds, but particularly to psychical influences, renders those who are its subjects peculiarly vulnerable to alcohol. It should be administered to such persons with great caution, and the medical attendant should see that its use is gradually and completely discontinued before losing sight of the case.

The uses of alcohol in disease are clearly indicated by the preceding short study of its physiological effects. It will be observed that nothing has been said of its effects upon the bodily temperature. The reason for this omission is that in small or moderate quantities it has no appreciable effect upon the temperature. When the dose is moderately large and the subject not accustomed to its use it may cause a slight elevation of temperature. And in cases of refrigeration, as after prolonged exposure to cold when the internal temperature has fallen to 97° F., 96° F., or even lower, it does undoubtedly help, through its action in restoring the equilibrium of the circulation and the activity of the cellular elements of the body, in bringing back the natural degree of heat. But when very large doses are given—say fl ℥ iij or fl ℥ iv of whisky or other spirit of proper strength—instead of causing an elevation, it brings about a positive diminution of temperature.

It is not, however, available for this purpose in fevers, or certainly to but a very slight extent, as the doses required would be but ill borne by most organisms. It has also been very satisfactorily proved by Arctic and other explorers —Rear Admiral A. H. Markham, Dr. Kane, Hall, Schwatka, and others—that alcohol is of little or no avail in *preventing* fatigue or the effects of long exposure to cold. And this is evident from what we have said as to its physiological action. But toward the end of the march, or when the exertion and exposure have terminated, it is of great value in moderate quantities as an aid in restoring the exhausted vitality—i. e., in keeping up a proper circulation and distribution of blood and the activity

of the cellular changes, until the exhausted tissues have been restored to their normal condition. But even here, except for its quicker action, dependent upon its more rapid diffusibility, it is not superior to strong tea or coffee. Indeed, Dr. Kane,* a most reliable observer, and one the adequacy of whose experience will not be questioned, gives tea the first rank as a restorative. Dr. Parkes,† too, who accompanied Stanley across Africa as surgeon to the expedition, gives similar testimony. Probably one of the greatest of the advantages of tea and coffee lies in the absence of temptation to excess in their use—at least to such excess as to involve the dangerous and lamentable consequences of too free alcoholic indulgence. Still, as already said, where prompt and powerful results are demanded alcohol maintains its place. It is not quite so prompt to act as ammonia and the ethers, but much more persistent. This subject will be again alluded to under the head of Cardiac Stimulants.

Hence, in administering alcoholic stimulants to fever patients we ignore its influence upon the temperature, with the exception of one point, which should always be clearly borne in mind—viz., that if it irritates the stomach, interferes with digestion, or, in very susceptible or idiosyncratic persons, unduly stimulates the nerve centres, it may increase the fever.

The special indications are great debility; rapid and small or irregular pulse; the nervous adynamia known generally as the *typhoid state*, characterized by hebetude, indifference, jactitation, twitching of the muscles, the so-called subsultus, muttering delirium, coma vigil, or even a more active delirium when accompanied by signs of great weakness elsewhere, a dry or brown tongue, sordes, and perhaps even involuntary evacuations of urine or fæces. All these symptoms are so many sign-posts on the road to dissolution, and call for active stimulation to sustain the patient until the rallying point is reached. Such a symptom group as that just delineated never occurs except in case of profound toxæmia by one agent or another, or as a result of inanition or great exhaustion. The main differences between the symptom group of inanition and that of toxæmia are that in the latter the skin is dry and harsh, and the temperature is lower, even subnormal. In *inanition* the skin and breath become most horribly fetid, the odour somewhat resembling that of bromism. In this condition we have often found that the inhalation of the vapour of alcohol, as already referred to, is a very valuable therapeutic resource. Sometimes it is difficult to introduce a sufficiently large quantity by the mouth or rectum, and sometimes the alimentary canal will not tolerate enough to overcome the extreme weakness and ataxia (or want of co-ordinate operation of the various nervous mechanisms). It may, under such unpropitious circumstances, also be introduced hypodermically. But even when the injections are thrown as deep as possible beneath the skin there is, with the trophic processes at so low an ebb, always danger of sloughing or the formation of abscesses. The latter may, to some extent, be avoided by first thoroughly cleansing the skin and then disinfecting the needle and syringe. For the latter purpose the author uses a strong solution of pure carbolic acid (from 10 to 20 per cent.), afterward rinsing the apparatus thoroughly with boiled water. Usually, however, the exhibition of stimulants is begun long before the patient has sunk into this condition, and if great care is observed in dieting and the use of drugs, more especially if the temperature is kept within bounds, the stomach becomes accustomed to the reception of stimulants, and it will not be necessary to resort to such extraordinary measures.

It is important, therefore, in treating febrile and inflammatory conditions, to watch carefully the pulse, eye, tongue, and general appearance of the patient, so as to begin the use of stimulants as soon as there is any sign of failure of the vital forces. In grave toxic conditions, such as *poisoned wounds*, no time should be lost, as, if the diagnosis is correct, we may rest assured that the sufferer will need all the aid we can give him from the very start. In the various *neurotic affections* alcohol in some one of its numerous forms is capable of giving prompt and very decided relief. I refer to *neuralgia*, *asthma*, *spasmodic colic*, etc. But while neuralgia and asthma are, as a rule, promptly relieved by alcohol, I do not by any means advise its employment as a remedy in these diseases. In fact, its use can not be too strongly deprecated. The disorders in question are essentially chronic in their nature and prone to frequent recurrence, and there is no class of affections in which the use of alcoholic stimulants is so fraught with the danger of the contraction of the terrible habit of inebriety, even in the case of the most conscientious and well-meaning persons. If matters are desperate and there seems to be no other means of relief, they should certainly be given under some of the disguises mentioned above, and their use entirely discontinued, as well as the chance of having prescriptions renewed done away with, before the practitioner loses sight of the case. The same precautions should be used when alcoholic beverages are employed in the treatment of *atonic dyspepsia*. For this condition, alcohol, administered directly after meals or taken in the form of a light wine or malt liquor during the meals, is a most valuable remedy. But equally good results can be obtained by the use of a bitter tincture in pretty decided doses, either immediately before or directly after meals. For *anorexia*, when this is dependent upon debility or anæmia, without structural lesions of the stomach, a moderate dose of whisky or other strong spirit fifteen or twenty minutes before going to the table is one of the best temporary remedies.

It may be given temporarily while we are waiting for the effect of whatever tonic is prescribed. Employed in this way, it is quite manageable, and if it is discontinued at the proper time

* *Arctic Explorations.*

† *Experiences in Equatorial Africa*, New York, 1891.

no danger need be apprehended, provided, of course, there is no predisposition to inebriety, a point in regard to which the conscientious practitioner will always endeavour to inform himself.

Alcohol is also a most valuable agent in the treatment of *shock*, whether arising from mechanical or other violence or from great psychical disturbances, such as fright, sudden or, at times, prolonged grief and anxiety, or perhaps too sudden emotional exaltation. It is doubtful whether the last cause is operative on healthy organisms, though such a case can be imagined; but, as a rule, with, we think, few exceptions, dangerous nervous adynamia as a result of sudden emotional perturbation, if we except some extreme cases of fright, suggests some already existing cardiac or nervous weakness or disease. It should, at all events, be the rule of practice in all such cases to examine the patient thoroughly, and if there is any indication of such a weakness or disease we should not fail to administer stimulants and to continue their use until we are perfectly satisfied that the vital mechanism is again running smoothly, even though the symptoms are not alarming, for in such instances the heart may, unless properly sustained, grow progressively weaker, and sudden, fatal syncope supervene, as in the accident called by surgeons "*masked shock.*"

The toxic effects of alcohol are acute and chronic. The milder acute toxic action is seen in those who have ingested too great a quantity, either through conviviality or by mistake. The action upon the alimentary canal reaches the point of intense irritation, with supersecretion of mucus, nausea, and vomiting. The renal irritation may be the cause of a greatly increased discharge of urine, or, if it is too intense, the swelling of the glomeruli may be so great as to impede the separation of water, or even lead to complete temporary suppression of the secretion. The blood being loaded with the products of an incomplete digestion, these are largely excreted by the kidneys in the forms of uric acid, oxalic acid, calcium oxalate, and urates, particularly the red urates; and, as a result of overstimulation of the nervous system and excessive glandular activity, the triple phosphates appear, frequently in large quantities, with altered colouring matters, so that the large quantity of limpid urine directly accompanying the debauch is followed by lesser quantities of a highly coloured, strong-smelling secretion, composed as we have detailed above. More serious symptoms, sometimes even followed by death, occasionally result from the drinking of enormous quantities of spirits. The symptoms are those of violent irritation of the gastro-intestinal canal, while the cerebro-spinal excitation is so great as to lead to active convulsions, followed by coma.

The treatment of ordinary *drunkenness* is, in the first place, thorough washing out of the stomach by emesis, usually best induced by the drinking of large quantities of warm water, complete rest, and the soothing effects of large doses of a bromide with large doses also of ammonia, either the acetate in the form of the liquor ammonii acetatis or the aromatic spirit. The cold pack is a very useful adjunct to the treatment. When convulsions and coma have been induced by an enormous dose, rectal injections of chloral, with the pack, and hypodermic injections of atropine, digitalis, and morphine, may be of use, though such cases are usually fatal.

Chronic Alcoholism. — If the more pronounced stimulating and narcotic effects of alcohol are induced repeatedly and for a considerable length of time, varying, of course, with the varying constitutions, circumstances, and mode of life which characterize individuals, there results, finally, a peculiar pathological condition to which we apply the term *chronic alcoholism.*

It is important that this condition of somatic disease should be distinguished from such psychical states as those indicated by the terms *mania a potu* and *inebriety.*

Although alcoholic inebriety is, in its terminal stages, usually complicated by evident visceral changes, it is not necessarily so. It belongs to a distinct species, a type of disturbance affecting the higher centres, or those in which the nervous activities by which the adjustment of the bodily functions to the changes in surrounding conditions is accomplished are translated into consciousness—the domain of the emotions, the intellect, and the will. Inebriety is, essentially, a psychosis, as is mania a potu; but chronic alcoholism is a condition of disease brought on by repeated indulgence in alcohol excesses, which may be simply the result of recklessness or evil surroundings.

It was formerly, in the United States and Great Britain, and is now in some countries, the custom, even in the best society, to drink to excess; and, no doubt, many who were not considered at all reckless or immoral acquired the lesions of chronic alcoholic intoxication. And the occurrence of inebriety at the present day is probably due to inherited tendencies exaggerated by a want of symmetry in the development of the cerebral mechanism, while simple drunkenness is the result of a careless or unprincipled yielding to a natural desire for stimulants and narcotics which seems to be common to all mankind, but which, fortunately, the vast majority of civilized men, at least, are able to control.

The evil effects resulting from the frequent and prolonged use of alcohol in excessive quantities are observed in the digestive and respiratory apparatus, the urinary organs, the nervous system, and the special senses. While it is convenient to describe the alterations in these various systems and apparatus separately, it is necessary also to point out their close relationship to each other, and the interactions which, in disease as in health, go to make up the sum of the phenomena presented for our study either by the individual parts or by parts associated for the performance of special functions. Thus, in describing the changes in the digestive organs, we shall see that, in addition to the alterations of structure and function in those specialized tissues whose functions are ex-

clusively digestive, there are also alterations in the other tissues which are included in the composition of the organ as a whole; and that the functional disturbances of at least two of these tissues—viz., the nervous and the vascular—are but the local manifestations of more extensive changes which are distributed throughout a great part, if not the whole, of the particular systems to which they belong.

We allude to this fact because it is one which, if borne in mind, may help us to a clear conception of the complicated morbid conditions which are present in cases of well-developed chronic alcoholism—conditions to which too little attention is paid by the profession in general.

The *digestive apparatus* is exceedingly complex, both in its anatomy and in its physiology, and the combination of its parts for the accomplishment of one grand function does not remove their liability to the pathological changes peculiar to their individual specific characters. The parts specially affected by alcohol are the mucous membranes, the glandular apparatus, the connective tissue, and the nervous mechanism. The muscular and serous coats of hollow organs (except the cardiac muscle, which is often found in a state of fatty degeneration with interstitial connective-tissue hyperplasia) and the lymphatic glands are not changed, anatomically at least.

The changes observed after the frequent and prolonged use of alcoholics in excessive quantities are such as would be expected to result from repeated irritation. The mucous membrane of the stomach and duodenum, but especially the former, is thickened and congested, the slight tumefaction being due to dilatation of the capillaries and small veins, and to a sort of œdema resulting from the accumulation of blood and retardation of its current. The glands, mucous and peptic, are not much affected, except that the cells are somewhat swollen, and there are evidences of increased proliferation. The most important change is in the connective tissue, not only interstitial tissue, but also that which enters into the composition of the walls of the veins and circumvenous lymphatics.

This connective tissue is thickened by hypertrophic growth, and the process, extending through the portal into the hepatic system, gives rise to a chronic interstitial hepatitis.

The liver thus becomes enlarged by increase in the bulk of its connective tissue and retardation of the venous current. Later on, however, the neoplastic tissue, in compliance with the law of its growth, condenses and contracts upon the other histological elements, and, by so doing, brings about a diminution in the size and an increase of the specific gravity of the organ. The glandular hepatic cells at first are irritated, and there is supersecretion of bile, but later on, if the pressure of the newly formed connective tissue is considerable, there is more or less atrophy, with inability to adequately perform its function.

The most important disturbances, however, are in the *nervous system*. Anatomically, it is not clearly made out to what extent there are actual alterations, but physiologically there is a very decided effect; and in the larger ganglionic masses of the solar plexus connective-tissue thickening has been noted. It is in all probability to the deranged innervation that the other changes are due.

Consequent on the exhaustion which follows overstimulation of the nervous system there is, in the abdominal viscera, great relaxation of the arterioles and venules with passive hyperæmia and alterations of the secretions. This is very evident in the morning, when, the effect of the stimulation of the preceding day having disappeared, there is great relaxation with supersecretion, flatulence, and hyperæsthesia. The first food taken is apt to be vomited, and it is only possible to retain the ingesta after enough alcohol has been taken to overcome the condition. The brain, too, is in a similar condition, and there are vertigo, headache, depression of spirits, intellectual torpor, and a tremor due apparently to diminished activity of the muscular sense. The vomiting which occurs on assuming the upright posture is undoubtedly a result of insufficient force in the cerebral circulation. Finally, if the use of the stimulant is suddenly stopped, this nervous condition becomes so pronounced as to culminate in the well-known condition of *alcoholic delirium*, or *delirium tremens*. The same result may also come from such great excess that the nervous system loses its ability to respond, which condition is equivalent to that caused by ceasing to take it. Or the acme may be reached in the occurrence of such an exhaustion of the cerebro-spinal vaso-motor system that, the blood accumulating in the capillaries and small veins, its watery constituents pass out into the subarachnoid space and the contiguous lymphatic spaces so as to produce a true *cerebral œdema*, or, as it is called in the hospitals, *serous apoplexy*. This is characterized by the sudden development of *coma*, usually associated with convulsions of a rather mild type—that is, with less violent muscular contractions than are seen in some other diseases—snoring, but rarely a typically stertorous breathing; a pale, cold, and moist surface; a weak, irregular, and small pulse, usually quite rapid; contracted or medium-sized pupils, which do not, so far as the writer has seen, vary in their dimensions; and, where it is possible to ascertain, no paralysis. The general appearance of the subject is suggestive of alcoholism.

In the course of an alcoholic career there may be certain diseased states which are undoubtedly symptomatic of it, but which occur in so small a proportion of cases that, unless the physician is aware of the tendency to them, and exercises due caution, he may fail to appreciate their significance. These complications are *peripheral neuritis*, or, as it was formerly called, alcoholic paralysis; *insanity*, which may be of either a maniacal or a melancholic nature, or, as a terminal condition, in rare cases, imbecility, dementia, or irregular nervous symptoms caused by chronic leptomeningitis or pachymeningitis in patches and giving rise to adhesion between the membranes or between the dura and the skull; and sometimes atrophy and hardening of the convolutions. These

latter lesions can only be suspected, as there are no certain diagnostic symptoms. *Pneumonia* of the asthenic variety is frequent and usually fatal.

Chronic nephritis is very often met with, and it is, I think, caused by alcoholism in so far as the latter induces that disturbance of the vaso-motor system already described. It is not, however, probable that alcohol induces chronic Bright's disease unless there is a predisposition to it. But when the character of the tissues is such as to favour the development of chronic nephritis under the incidence of a suitable exciting cause, there can be no doubt that the excessive use of alcohol may be the means of initiating the disease; and I think it highly probable that its baleful influence is exerted indirectly through the agency of the solar and renal plexuses of the abdominal sympathetic. Through the nervous system, again, it is that the *pneumonia of drunkards* is caused. At least it is a fair inference that the effect of alcohol on the vaso-motor system and the trophic nerves is responsible for this asthenic inflammation of the lungs, which may perhaps be started by a cold; for, in addition to the results produced in the physiological laboratory by section of the pneumogastrics, we have the established clinical facts of the development of asthenic pneumonias under conditions of great debility and shock to the nervous system, such as fracture of the femur in old persons, the slower, destructive changes in diabetes, the pneumonia of diphtheria, etc.

The *vascular system* suffers also, and not only in its capillary field, as already mentioned, but in the heart itself, which, greatly disturbed in its function as the immediate result of debauches, finally loses its muscular tonicity, and the walls become flabby, the cavities dilated, and the beat feeble, irregular, and inefficient.

The *diagnosis* of chronic alcoholism under ordinary circumstances presents no difficulties to the experienced physician, at least none sufficiently great to require any discussion in this place.

There are, however, certain circumstances or occasions when its distinction from other graver conditions is of the utmost importance.

This is the case when alcoholic coma or serous apoplexy occurs, and especially when, as is not uncommon, there is no history, the patient being unconscious and, perhaps, found in this condition in the street. The diseases and injuries with which it may be confounded are opium coma, cerebral apoplexy, uræmia, diabetic coma, and fractures of the skull, especially of the base, as fractures of the vault are usually accompanied by visible or palpable injuries to the soft parts. In the first place, we will say that the physician must not allow his judgment to be influenced by the fact that there is an alcoholic odour from the patient's breath. I have seen a most unfortunate result follow the neglect of this rule.

Opium or *morphine coma* is usually readily distinguished by the pin-point pupils, the extraordinarily slow respiration, with rapid pulse, the well-marked lividity of the surface, and, when opium or its fluid preparations have been taken, the odour. In case of doubt the stomach-pump should, of course, be used. In *apoplexy* the respirations are, if anything, a little slower than normal, with stertor which is not an ordinary snore, for not only the palate, but all or many of the facial, buccal, and cervical muscles are paralyzed. The cheeks draw in, if the paralysis is profound, the tongue frequently moves a little backward with the inspiration, the larynx is abnormally mobile, and the lips and cheeks puff out with a sort of blowing position and noise during expiration. The pulse is usually slow, full, and, almost without exception, irregular at some time during the stage of coma.* The heart sounds are loud and distinct if there is no degeneration. The general appearance of the patient is also a guide, sometimes a most important one, for it would be a remarkable experience to find a case of alcoholic coma which did not present the outward evidence of long-continued dissipation; while, on the other hand, though chronic alcoholism may be complicated by apoplexy, the great majority of the cases of the latter disease occur in persons who are not the victims of drunkenness.

Uræmic coma is above all other forms difficult to distinguish from the coma of chronic alcoholism. The source of error lies in the fact (which has not, so far as I know, been noticed by the authors of systematic treatises on the subject) that the anatomical condition of the nerve centres is almost identical in the two diseases.

Uræmia, to be sure, is a toxic condition, but the post-mortem appearances in cases where death has been preceded by convulsions and coma are such as to suggest the idea that the primary effects of the disease were upon the vaso-motor apparatus; and that, this apparatus being disordered, there ensued a dilatation of the capillaries, arterioles, and venules, with passive hyperæmia, blood stasis, and transudation of serum into the lymphatic spaces, circumvascular, perineural, and pia-arachnoid. The nerve cells are in both diseases partially devitalized, first by the poison, and secondarily by lack of normal arterial blood, and, their reflex activity being greatly reduced, they no longer receive or co-ordinate the impressions made by external forces on the peripheral nerve endings. When this failure of excitability reaches a point where that co-ordination of impressions from without and reproduced images of former mental states from within which is necessary for the production of ideas is lost, consciousness is abolished, and a state of stupor or coma supervenes. But, notwithstanding all this, it is, in most cases, possible to make a correct diagnosis. A careful review (comparison) of the symptom-complexes of uræmia and alcoholic coma will show us that, while the resemblances between them are numerous and very distinct, there are also important differences of which some will always be present.

* This statement will scarcely find support from the writers on the subject. I have, however, carefully examined many cases, taking the pulse as often as possible, and have almost invariably found irregularity at some period.

The *ensemble* of the symptoms is of great diagnostic moment in these cases; for, while a person suffering from chronic alcoholism may have nephritis, which, indeed, if it were typically developed, would bring the case into its own class, it would, when it was simply a complication, alter the symptomatology so little as not to attract attention, and we may therefore ignore it in preliminary examinations, such as are required on a person's admission into a hospital.

If a person suffering from chronic alcoholism should become affected with a chronic nephritis of sufficient gravity to have the characteristic symptoms of that disease, the clinical aspect of the case would be changed by the addition of the following to the signs already presented: 1. *Anasarca.* Alcoholism alone may give rise to some œdema of the feet and ankles, and to a general puffiness, but it is not like the yellowish-white, tense œdema of dropsy, and it is not so extensive. 2. If the nephritis commences at an early enough period, before the nutrition of the body is too seriously damaged, the heart will be larger, the apex beat stronger, the radial pulse larger and more tense. 3. In the condition supposed to be present at our examination there will be, as a rule, more pulmonary œdema. 4. The urine, of which a little may almost always be obtained with a catheter, will be much more albuminous than in alcoholism alone. 5. There will be, as a rule, more convulsions. These points, derived from a study of the changes which might be expected if chronic nephritis were added to chronic alcoholism, are the diagnostic points of the two affections, and they may easily be recalled by reverting to this method of elucidating them.

Diabetic coma is easily distinguished if the physician does not overlook the possibility of its occurrence. It is so rarely met with in general practice that there is a chance of its being forgotten, and I have on one occasion seen such a case incorrectly diagnosticated by a skilful practitioner, who, never having seen diabetic coma before, failed to consider it. In so far as alcoholic coma is concerned, the diagnosis is very easily made. These are the points: 1. The patient is thin or shows evidences of being in the course of emaciation, *e. g.*, a loose and finely wrinkled skin. 2. The skin is dry, harsh, compact, clinging to the subjacent parts with little or no subcutaneous fat, or what there is devoid of succulence, the reverse of what we see in chronic alcoholism and chronic Bright's disease. 3. The respiration is slightly increased in rapidity, is deep and laboured, yet there is an appearance of dyspnœa, sometimes marked cyanosis. The pulse is very rapid and very feeble. 4. The examination of the urine is suggested by the peculiar ethereal odour of the breath, and the diagnosis is then certain.

The diagnosis between alcoholism and *fracture of the skull* with compression of the brain, either by depressed bone or by effused blood, is of the greatest importance.

The liability to error is greatest when the fracture is at the base of the cranium, as there is no external evidence of it unless the solution of continuity passes through the auditory portion of the temporal bone or through the ethmoid cribriform plate, allowing of the escape of the subarachnoid fluid. Of course, bleeding from the ears, deep-seated orbital effusions of blood, etc., are important symptoms in directing the surgeon's attention to the base of the skull. It is almost a daily occurrence in our large cities to have persons brought into the hospitals who have been seen to fall or been found lying in the street or other places, and, on examination, to find them comatose but without any mark of injury about the head. It has happened too often that such a person has been refused admission on the ground of drunkenness, and that he or she has, perhaps within a few hours, died in a cell, and the coroner's investigation has shown that there had been a fracture at the base of the cranium, with hæmorrhage and, frequently, contusion of the cerebrum from the *contre-coup.* We will compare the symptoms, omitting the alcoholic odour of the breath, or, rather, mentioning it in order to warn ambulance surgeons and others of the danger that lies in considering it as a symptom of alcoholism, for that has been the cause of most of the terrible mistakes.

We will suppose a case without any previous history, and we must here include the alcoholic coma that results acutely from the ingestion of an enormous quantity of the drug within a short space of time, as in a case seen by the writer in which the patient, a young man, on a wager, poured a pint of gin into his stomach at one draught. Within, probably, two or three minutes he fell to the floor comatose, and almost immediately was seized with violent tetanoid convulsions, which only ceased at his death, which occurred in a few hours.

In fracture at the base of the cranium there is, as a rule, immediate unconsciousness from concussion. From this the patient may rally partially, so as to make some sign of intelligence, and then slowly relapse into a coma which is usually not so profound but that there will be some restlessness and occasionally great irritability. The breathing becomes noisy, each expiration being accompanied by a groan. Later, the stertorous breathing comes on. When the primary shock has passed away, the *surface* regains more than its natural heat, and, within a few hours, the *temperature* rises two or three degrees. The *pulse* is usually more rapid than in apoplexy, but of good volume and strength, until the "beginning of the end." It is, however, irregular; the more so, the greater the danger. Intermittency of the pulse is a gloomy prognostic.

The *breathing*, at first superficial from the concussion, gradually deepens, not increasing much in rapidity. It is, however, very deceptive in this respect, for the partial or complete paralysis of some of the muscles of inspiration —*e. g.*, the diaphragm—throws on the other muscles the necessity of more vigorous contraction, and gives the impression of laboured breathing. The *pupils* are not in either condition affected in any way that is constant and typical. If, however, they are unequal in size, as they frequently are in cerebral hæmorrhage, it is a strong point in favour of cerebral injury as

against the coma of either acute or chronic alcoholism.

The mode of development of the coma is important to the diagnostician. After an injury of the brain, from external violence or from apoplexy, when the shock has passed away, there is usually a gradual progression, from stupor or hebetude, from which the patient can be partially roused, to complete unconsciousness.

The alcoholic coma is, or has been in every case that has come under my notice, fully developed when the doctor first sees the patient.

Such persons are not brought to the hospital or seen at their homes so soon as the subjects of injuries and apoplexies are; and it is probable that even when they are with their friends, who are accustomed to seeing them sleep heavily under the influence of drink, the more serious condition is not immediately recognised.

Besides these distinguishing signs, there are some which are of minor pathological import, but which are useful to the diagnostician. One of these is the condition of the *tongue*, which in an advanced case of alcoholism would be foul, but might remain comparatively clean for the first few hours after the receipt of a severe head injury. The personal appearance of the patient is also worth noting in cases of coma of which we can get no previous history. Chronic alcoholic conditions, for instance, are commonest in middle-aged men; and when they occur in women the evidences of debauchery are usually unmistakable.

The majority of cases of fracture of the skull are seen in labouring men. The habit of drinking freely is very common among them; and when at work, what with their soiled working clothes, sunburned faces, and general unkempt appearance, very little help comes from outward inspection. As a rule, however, if they are injured while at their work, they are accompanied by some of their fellow-labourers. But an acute clinical observer will, in most cases of chronic alcoholism in labouring men, be able to discern certain differences between the external appearance of them and of steady men.

Though the colour of the skin may not differ materially in the two, it will be found that many of the small cutaneous veins of the heavy drinker are plainly visible—more so than would be accounted for by exposure.

The muscles have not the same tone. There is usually more subcutaneous fat, and this is of a more oily character, while the increased and vitiated secretion of the sebaceous glands gives a greasy look and feel to the skin, and, besides, a peculiar greasy odour, which I have noticed even in men who were scrupulously clean. The eyelids are, as a rule, a little swollen, and their cutaneous covering exhibits an abnormally large number of fine wrinkles.

We should never lose sight of the fact that chronic alcoholism and a fractured skull may coexist in the same person. We may say, finally, that it is the rule in all well-regulated hospitals—at least so far as my knowledge extends—in any case about which there is the least uncertainty, to give the patient the benefit of the doubt, and to adopt such treatment as would be proper in any event. Fortunately, this plan is practicable, as the central factor in each is an injury to and pressure upon the brain.

The *treatment of chronic alcoholism* affords an excellent illustration of what is known as *rational therapeutics*, but, unfortunately, in cases which have advanced so far as to have well-marked visceral lesions there is little hope of success beyond some temporary mitigation of suffering, as the lesions are essentially degenerative.

If the anatomical alterations in the viscera are not very far advanced, and not so extensive but that, if their progress can be stopped, there will remain enough of the specialized tissues to carry on their organic functions, it is possible to restore the *bodily* health—if not completely, at least sufficiently to enable the person to live a comfortable and moderately active life. The most important indication is to stop the taking of alcohol entirely and permanently. Whether in a given case it is safe to stop it suddenly or not must be decided by the attendant. There are certain drugs which will assist very materially. The best are strychnine and the cinchona preparations.

The following is a valuable combination:

℞ Strychnin. sulphat....... gr. j;
Tinct. cinchon. comp..... f ℥ iij.
M. Sig.: A teaspoonful every two hours.

The alleged gold compounds have been greatly extolled of late, but I do not feel warranted in indorsing them as yet, as it requires long and careful clinical observation to establish such allegations as are made for them. For the restoration of the nervous system, so far as that is possible, the salts of iron, zinc, and arsenic are very useful; and in many cases the bichloride of mercury may prove to be of service, particularly when the glandular apparatus, hepatic and peptic, is much deranged.

To secure proper nutrition, which is the next step of importance, such light and wholesome diet must be prescribed as, in the judgment of the practitioner, is most suitable for the individual, and *the directions for the feeding should be specific and written out by the attendant.*

In most cases liquid food is necessary at the beginning, but as soon as the stomach is capable of retaining it we should give beef and mutton or lamb. If the gastric catarrh is rebellious it may be conquered by lavage—a measure which in my hands has never failed. It is best in most cases to diminish the stimulant gradually, and aim at getting the patient up to the digestion of solids by the time the alcohol is omitted.

Of almost as great importance is the procuring of sound sleep. To this end a warm bath at eventide, and twenty to thirty grains of sulphonal directly after it, will usually be successful.

If a more powerful hypnotic is needed, at first a drachm of paraldehyde at bedtime, and repeated in an hour, is the best:

℞ Paraldehyd.,
Ol. amygd. express., part. æqu.
Sig.: Two teaspoonfuls at bedtime.

Another very important measure is a change of air and surroundings. Of course the subsequent abstention from alcoholic drinks must be accomplished through the patient's own volition; but he can be assisted by proper treatment and encouragement.

I have found, too, in many instances that the mixture of strychnine and tincture of Peruvian bark—the formula for which I have given above—is so good a substitute for the alcoholic liquors to which these patients are accustomed that while taking it they have very little if any craving for strong drink.

Of the different forms in which alcohol can be administered something has already been said. It will suffice to add that the so-called spirits—viz., whisky, brandy, rum, gin, and arrack—contain about 50 per cent. of alcohol.

The heavy wines—port and sherry—contain about 20 per cent., but are usually too sweet for administration to sick people. When "dry," however—i. e., free or nearly free from sugar—they are frequently useful, particularly with convalescents and debilitated persons. The light table wines—claret, Burgundy, Hock, and the Rhine wines—have from 5 to 10 per cent. alcohol in their composition; but many of the Rhine wines, on account of the oxalic acid which they contain, are not at all suited to those who have any tendency to the oxalic diathesis. Malt liquors—viz., ale, stout, and beer—are especially tonic in their effects, and the diastase which is usually present in them aids the digestion of starchy foods. For this reason, probably, they have a tendency to produce obesity. The stronger ales and stout or porter contain from 12 to 15 per cent. of alcohol, while the lighter beers have only 3 or 5 per cent. The smaller percentage of alcohol in the latter and in the light wines causes them to ferment when exposed to the air in warm weather or warm rooms, so that great care should be taken to see that they are perfectly clear before they are given to the sick person. The slightest turbidity is sufficient to condemn them. When decanted and held toward the light they should be as clear as water, otherwise the torula has already begun to grow in them, and they are unfit to drink.

To the final question, *Is alcohol a food?* we must, in the present state of physiological science, answer unqualifiedly in the affirmative. Those physiological chemists who have succeeded in recovering pure alcohol from the blood, secretions, or exhalations of men or animals to whom it has been given have never recovered but a small percentage of it. It also unquestionably retards the waste of tissue, and this directly apart from its action upon the nervous system. This does not, however, in any way detract from the dangers of its consumption, though justifying still further its employment in disease.—B. F. Westbrook.

ALDEHYDE.—The aldehydes (dehydrogenated alcohols) are alcohols deprived of two atoms of hydrogen in the molecule. Ordinary aldehyde is *acetic aldehyde*, C_2H_4O, a very volatile, pungent, transparent liquid, readily oxidizing into acetic acid. It mixes in all proportions with water, alcohol, or ether. Employed in a 15-per-cent. alcoholic solution, it is a remarkably potent antiseptic. Cf. Paraldehyde.

ALDEHYDUM TRICHLORATUM.—See Chloral.

ALDER.—See Alnus.

ALEMBROTH.—Sal alembroth, chloride of ammonium and mercury, $(NH_4)_2HgCl_4+2H_2O$, has been recommended by Sir Joseph Lister as a substitute for corrosive sublimate in antiseptic dressings. It is readily soluble in water, and is not so violent a poison as corrosive sublimate. It is used in a 1-per-cent. solution.

ALETRIS.—The rhizome of *Aletris farinosa* (star-grass, colic-root, etc.), a hæmodoraceous plant, is a bitter tonic, and, in large doses, emetic and cathartic. It has been said to be efficient as an emmenagogue and as a remedy for dysmenorrhœa, but there is a lack of careful observations to justify the statement. The dose is 10 grains of the powder, a tablespoonful of an infusion of 1 ounce of the rhizome in 1 quart of water, or 10 minims of a fluid extract (the *extractum aletridis fluidum* of the Nat. Form.).

ALEXINS are certain products obtained from cultures of pathogenic micro-organisms. They seem to confer upon an organism into which they are injected immunity against the diseases caused by the micro-organisms from which they were originally obtained. Tuberculocidin is an example.

ALEXIPHARMACS.—See Antidotes.

ALIMENTATION.—Diet appeals to the physician in a twofold aspect—as a means of nutrition, and as a therapeutic agent. He gives instructions regarding the diet of pneumonia and scarlet fever for the purpose simply of maintaining the nutrition of his patient. He prescribes certain diet in scurvy and diabetes with the additional object of aiding in the cure of the disease. In the present article the subject of diet in health and disease is alone considered. Food as a *therapeutic agent* is considered in the article on Dietetic Treatment. Closely allied to these two subjects is that of Foods, and to the article thus entitled the reader is also referred.

The daily amount of food required by the average human being has been determined by various observers. The results of their investigations are of great value in determining the amount of food necessary for the maintenance of large bodies of men. While the average amount necessary to sustain life and maintain health may be determined by investigations of this character, it is folly to attempt to feed the individual according to set rules regarding the percentages of the various proximate principles. Numerous factors must be considered in each individual case. The most important of these are age, climate, season, occupation, and idiosyncrasy. Age is a most important factor, and will be discussed at greater length hereafter. Climate and season have a marked influence not only upon the character of the food, but upon the amount ingested. In

cold climates fats and meats are largely used; in hot climates the use of fruits and vegetables predominates. Occupation is another element of the greatest importance. A change in occupation and surroundings is frequently not properly considered. The country boy who eats fat pork and indigestible pastry with impunity on the farm, becomes, if transplanted to the city, a dyspeptic on a much more digestible diet. The labourer requires more food than the student, and entirely different food. Idiosyncrasy must explain many peculiarities both in the character of food desired and in the amount consumed. Some people are habitually hearty eaters and consume enormous amounts of food without digestive disturbance. Others are habitually small eaters and maintain perfect health upon a surprisingly small quantity of food. This is especially noticeable in children. The physician is not infrequently consulted by an anxious mother who fears that her child, who is apparently in perfect health, is not eating sufficiently.

Overfeeding is perhaps the most common error made in diet. It is almost universal among young children who are artificially fed, being far more common than the opposite extreme of underfeeding. Overeating probably accounts for more dyspepsia than the eating of improper articles of diet does. The theory, however, that a person should stop eating before the hunger is appeased is not worthy of serious consideration. Among infants overfeeding leads to indigestion, flatulence, colic, diarrhœa, and malnutrition. Among adults it produces constipation and dyspepsia with all its attending woes.

Insufficient diet, though comparatively less common, causes very decided symptoms. Acute starvation is characterized by a feeling of hunger and intestinal uneasiness, which soon changes to actual pain. The various secretions are diminished, especially those of the intestinal canal, and constipation becomes pronounced. Digestion, when food is taken, is imperfect. The respiratory movements are diminished, the blood is diminished in amount and loses its power of coagulation, and a tendency to extravasation is developed; the urine decreases in amount, and the urea is diminished in quantity. The temperature, which at first may be elevated, falls below the normal. Vertigo develops, and the mental faculties become deranged. The fat disappears and the muscles themselves diminish. A loss of 40 per cent. of the average weight has been observed in persons who have recovered. Acute starvation in infants during the first few days of life is probably not very uncommon. It is marked by restlessness and a high temperature, which falls as soon as the child receives proper nourishment. Fever in a very young infant, unless clearly explained by other causes, is very suggestive of starvation. Investigation may show that a child who is supposed to be nursing properly is getting practically no nourishment from the breast.

Insufficient nourishment not infrequently causes peculiar and obscure symptoms. It is sometimes seen among children who are fed upon condensed milk. As a rule, this article of diet is diluted far too much, the fat being especially deficient. These children are anæmic, rhachitic, and always restless and troublesome. They suffer from indigestion and malnutrition, and perhaps from athrepsia. Alcoholic drinkers are frequently found in a state of actual starvation. The excessive use of alcohol destroys the appetite for food. It is the rule to find that those patients who have been drinking heavily have been without food for days or even weeks. Proper nourishment is one of the most important elements in the treatment of these cases. Symptoms resulting from insufficient food are frequently seen among over-worked women whose chief diet consists of tea and bread or cake. They suffer from a condition to which the term starvation dyspepsia has been very appropriately applied. Many cases of anæmia among women are due in large measure to a diet which contains an insufficient quantity of nourishing food. The amount of food ingested may be sufficient, but it is so innutritious, if not actually indigestible, that the woman suffers, in fact, from a mild form of starvation. Hard-working students not infrequently suffer from the same condition.

Closely allied to deficient feeding is a diet consisting exclusively of a few articles of food. The teeth, the digestive organs, and the digestive secretions all point to the fact that man is an omnivorous animal. If too much reliance is placed on a single article of diet, decadence is certain to follow. This has been frequently observed in Ireland during times of distress, when the people have lived very largely upon potatoes. Such large quantities of the given articles must be ingested to satisfy hunger that the digestive organs are overtaxed and are unable to perform their functions properly.

Alimentation in Health.—A diet suitable for the adult must possess the proper proportions of the proximate principles in digestible form. It must be adapted to the habits of the individual, and must vary with the season and occupation. The relation between carbon and nitrogen in ordinary food should be sixteen and six tenths to one. The proportions of these elements in proteids is three and five tenths to one. In an exclusive diet of lean meat, over six pounds of beef would be required to furnish the proper amount of carbon. This would contain an excessive amount of nitrogen, which would disturb the digestion and place a great burden upon the kidneys. An exclusive diet of carbohydrates in the form of cereals, to supply the needed amount of nitrogen, would furnish twice the necessary amount of carbon. In an exclusive vegetable diet the proteid is so diluted by insoluble cellulose and unnecessary starch that large volumes must be taken to obtain the required amount of nitrogen.

The hydrocarbons and fats oxidize much more readily than the proteids. They have therefore been termed proteid-sparing foods, as they protect the proteids from oxidation and preserve them for other purposes. The carbohy-

drates and fat can replace each other to a certain extent. They are both produced in the body, from the proteids. This does not occur, however, when sufficient fat is present in the food. Fat is formed in the body in three ways: It may be formed from fat taken as food; it may be formed from the carbohydrates; it may be formed from the proteids of the tissues. This last process is due to retrograde metamorphosis, and is a step in the degeneration of tissue. These facts are additional proof of the necessity of a properly mixed diet. The following table, approved by Playfair, Pettenkofer, Parkes, and others, shows the amount of proximate principles required by the adult in the following conditions:

SUBSTANCES GIVEN DAILY.	Subsistence.	Ordinary labour.	Active labour.
Albuminates	2·0 oz.	4·5 oz.	6·5 oz.
Fats	0·5 "	3·5 "	4·0 "
Carbohydrates	12·0 "	14·0 "	17·0 "
Salts	0·5 "	1·0 "	1·3 "
Total	15·0 oz.	23·0 oz.	28·8 oz.

Translated into the terms of ordinary foods, the daily supply for an adult doing ordinary work is as follows:

1. Bread	18	ounces.
2. Butter	1	"
3. Milk	4	"
4. Bacon	2	"
5. Potatoes	8	"
6. Cabbage	6	"
7. Cheese	3½	"
8. Sugar	3½	"
9. Salt	¾	"
10. Water, alone and in tea, coffee, beer.	66½	"

The amount of dry substance in this diet is 1 lb. 5⅝ oz., though the total weight is 6 lbs. 14½ oz. Porter advises the following diet, which he believes yields the largest heat production, and also supplies the full quota of the various proximate principles: Wheat bread, 7 oz.; eggs, $3\frac{6}{10}$ oz.; milk, 24 oz.; meat, 14 oz.

Practically, the diet of any given individual is determined largely by his education, his social standing, and the habits of those by whom he is surrounded. Times and method of taking food, both important factors in maintaining healthy digestion, are dependent chiefly upon custom and habit. Regular intervals between meals are important, but no rule can be given as to the proper time for taking the heartiest meal. In warm climates but little food is taken during the heated part of the day, the heartiest meal being eaten late. In large cities the same custom is adopted from necessity or convenience. While there are objections to eating a hearty meal late in the day, there are certain marked advantages in not loading the stomach during the hours of active labour and business. Most of these matters are beyond the control of the physician and sanitarian.

The importance of proper cooking can hardly be overestimated. Prevailing methods of cooking have a vast influence upon the welfare of a nation. Although the chief object of cooking is to increase the digestibility of food, it would be an error to suppose that this was the only object. The most skilful cooking does not accomplish this in all cases, but bad cooking has a powerful influence in rendering food unfit for use. Raw pork digests in three hours, while roast pork requires over five hours. Boiled potatoes require three hours, while roast potatoes are digested in two. The chief effect of cooking upon vegetable foods is the breaking up of the starch grains, which in the raw state are uninfluenced by the digestive juices. Cooking converts the insoluble collagen of animal foods into soluble gelatin, and disintegrates the connective tissue. This action on the connective tissue is of great importance and counterbalances the fact that the proteids are often rendered more insoluble. There is a tendency to prescribe foods containing a carbohydrate or proteid without regard to their digestibility. If the proteid is so changed by cooking as to render absorption impossible, it is equivalent to omitting it from the diet entirely. Frying is probably the most deleterious method of cooking, as it saturates the article with oil, thus effectually preventing any digestion in the stomach. This may be, to a large degree, obviated by dipping the article to be fried in egg albumen and submitting it at first to a high degree of heat. The albumen is quickly coagulated, thus preventing saturation with oil. In roasting, baking, boiling, and frying, it is important that the temperature during the first few minutes should be at least 212° F. If the temperature is then reduced to 160° F., the juices of the interior portions of the meat remain largely uncoagulated and far more digestible and palatable. The same is true of boiling, except where broth or soup is to be made. It is important that meat should be thoroughly cooked to destroy the parasites with which it is liable to be infested. It should be raised to a temperature of at least 160° F. Meat of a blood-red colour has not, as a rule, been raised to this temperature, and is not wholly safe. Any food, whether animal or vegetable, which is open to the suspicion of being infested by parasites should be subjected to a temperature of at least 212° F.

Alimentation in Disease.—*Artificial Digestion.*—In conditions of great debility the digestive organs are sometimes incapable of properly disposing of even the most digestible food. This is of frequent occurrence not only during the course of acute disease, but also during convalescence. A condition of weakened digestion is sometimes seen among infants, even when they are not suffering from actual digestive disorders or other disease. The necessity for predigested food in such cases is frequently very great. To Dr. Roberts, of Manchester, we owe a method of peptonizing food which is extremely efficacious. Although the term "peptonizing," which has been applied to this method, is a misnomer, it has obtained a firm foothold and is universally employed. It consists in digesting milk, gruel, or meat by the use of extract of pancreas rendered alkaline by bicarbonate of sodium. It was formerly difficult to obtain these digestive ferments in proper condition. Being of animal origin, they rapidly decomposed. They

can now be obtained at most pharmacies in satisfactory condition. The most reliable and convenient method of performing this process is by means of the so-called *peptonizing tubes.* Sufficient extract of pancreas and bicarbonate of sodium to digest one pint of milk are placed in each tube. The tubes are tightly closed with corks covered with wax, so that the contents remain unchanged almost indefinitely. Each tube contains five grains of extract of pancreas and fifteen grains of bicarbonate of sodium. The following is the ordinary method of preparing peptonized milk: Into a clean quart bottle put the powder contained in one of the peptonizing tubes and a teacupful of cold water; shake, then add a pint of fresh cold milk, and shake the mixture again. Place the bottle in water as hot as can be borne by the hand without discomfort and allow it to remain from five to twenty minutes. Put the bottle on ice at once to check further digestion. The degree of digestion is very simply regulated by the length of time that the milk is kept warm. If this process is carried too far the milk is rendered bitter and unpleasant to the taste. To avoid the bitter taste, the milk may be prepared quite satisfactorily by the cold process. The water, milk, and powder are mixed as in the ordinary process, and the bottle, instead of being placed in the warm-water bath, is placed directly in contact with ice. The taste of the milk thus prepared is not changed. Milk may be completely peptonized by allowing the bottle to remain in the hot water for two hours. It may then be heated to boiling and strained. This so completely converts the casein to soluble peptone that the milk does not curdle upon the addition of an acid. This form of food is most valuable in many conditions. The unpleasant taste is the chief disadvantage. This may be overcome for many patients by the addition of lemon juice and sugar to form a *milk lemonade.* The different effervescent mineral waters, with or without an acid, sometimes render it palatable. In many cases of delirium or partial unconsciousness, or for rectal feeding, the taste is not objectionable. *Peptonized milk punch* may be made as follows: Take a goblet about one third full of cracked ice, pour on it a tablespoonful of St. Croix rum, with a dash of Curaçoa or other liqueur that is agreeable to the taste. Then fill the glass with peptonized milk, sweetened if desired, stir well, and grate a little nutmeg on top. *Peptonized gruel* is made by combining half a pint of hot gruel with an equal quantity of fresh cold milk. Mix and strain into a bottle and add the contents of a peptonizing tube. Allow it to stand in a warm place for twenty minutes, then place it on ice. The bitter taste of the milk is almost completely covered in this mixture. The gruel may be made from arrowroot, barley, flour, oatmeal, or maize meal. The farinaceous materials should be boiled with water until the starch grains are completely broken up and incorporated with the water. *Peptonized beef* may be made as follows: Take a quarter of a pound of finely minced, raw lean beef and half a pint of cold water. Mix in a saucepan, and cook over a gentle fire, stirring constantly until it has boiled a few minutes. Then pour off the liquor for future use, and beat or rub the meat to a paste, and put it into a clean fruit jar with half a pint of cold water and the liquor poured from the meat. Add twenty grains of extract of pancreas and fifteen grains of bicarbonate of sodium. Shake all well together and keep in a warm place, at about 110° F., for three hours, stirring or shaking occasionally; then boil quickly. It may then be strained or clarified with white of egg. Season to taste with salt and pepper. For most cases it will not be required to strain the peptonized liquor, for the portion of meat remaining undissolved will have been so softened and acted upon by the pancreatic extract that it will be in very fine particles and diffused in an almost impalpable condition. *Junket* is a very delicate preparation of milk for the sick and convalescent. It is made as follows: Take half a pint of fresh milk, heated lukewarm, add a teaspoonful of essence of pepsin or liquid rennet, and stir just enough to mix. Pour into custard cups and let it stand until firmly curdled. It may be served plain or with sugar and grated nutmeg. It may be seasoned with fruit extracts or wine. An egg beaten to a froth and sweetened with two teaspoonfuls of sugar may previously be added to the half pint of milk, forming a highly nutritious jelly. *Whey* is made by curdling warm milk as above directed, then beating up with a fork until the curd is finely divided, and straining out the whey. It is a fluid food peculiarly useful in many ailments, and always valuable as a means of variety in diet for the sick. It is frequently resorted to as a food for infants to tide over periods of indigestion and diarrhœa.

Rectal Alimentation.—It is frequently necessary to maintain nutrition by means of nutrient enemata. It is often advisable or necessary to give the stomach absolute rest. Feeding by the rectum in such cases becomes a most important procedure. Absorption from the rectum is fairly active, but no digestion takes place in that organ. It is sometimes so irritable that feeding by this method is impracticable. This is especially true in infants and children. This irritability can be overcome in some cases by the addition of small amounts of opium or chloral to the enema. The amount of fluid employed should not be large. Four ounces is as much as will be tolerated by most persons. Others will retain six or even eight ounces. The temperature of the enema should be raised to about 100° F. It should not be repeated more frequently than once in four hours. If irritation occurs, the time should be extended to six or eight hours, or the injections should be omitted entirely for twelve or eighteen hours. When it is desired to employ this method for more than one or two days, daily irrigation of the rectum with warm water to which a little borax has been added will do much to allay the irritability. It will also wash away masses of unabsorbed residue, which do much to prevent the continuance of the injections. The injection may be given

with the ordinary bulb syringe, but a six-ounce barrel syringe, designed for this purpose, is preferable. With care and patience rectal alimentation may be successfully continued for weeks, or even months in some cases; in others, in spite of every precaution, it becomes impossible. As a rule, nutrition can not be maintained by rectal alimentation for more than two or three weeks.

The best material for this purpose, in most cases, is completely peptonized milk. Whisky may be added if a stimulant is required, and also opium, chloral, and other drugs when indicated. An egg thoroughly beaten may be added to each enema. Beef tea has been successfully employed for twenty-eight days. If for any reason milk is contra-indicated or if a change is desired, defibrinated blood may be employed. The blood must be defibrinated at the moment it is drawn by stirring it with a bundle of twigs. The chief objection to blood is that in most cases the stools become very offensive and a fetid odour is more or less constantly present. Bovinine sometimes forms a valuable addition to the ordinary enema. A good *meat injection* consists of five ounces of finely scraped meat, which is rendered still finer by chopping. It is then mixed with three ounces of warm water in which extract of pancreas and bicarbonate of sodium have been dissolved. It is allowed to stand for an hour, and is injected through a wide-mouthed syringe.

An *enema of beef extract* not strictly for nutritive purposes is now sometimes used by surgeons to overcome *shock*. Six or eight ounces of warm beef tea made from Liebig's extract, rendered a little salty, are injected, together with a little whisky. This has a decided effect in overcoming shock during or immediately following an operation. It is much more effective than an injection of stimulants alone. This is due either to more rapid absorption or to the stimulating effect of the beef extract.

Peptonized suppositories composed of meat and milk may be used for alimentary purposes. They are fairly effective for short periods of time, but their use can not be long continued.

Forced Feeding.—It sometimes becomes necessary in cases of insanity to introduce food into the stomach by force. In serious injuries and operations about the throat the same method of feeding may be required when rectal feeding is contra-indicated. In cases of this character a catheter or long rubber tube may readily be passed through the nose to the œsophagus, and thus into the stomach, through which aliment may be introduced. The term "forced feeding" is also used in another and quite different sense. [Compare the article on GAVAGE.] As proposed by Debove, it is a method of treating phthisis and other wasting diseases. It is known that the power of digestion does not depend upon appetite. The peculiar fact has been demonstrated that a stomach that has rejected all food taken by the mouth will retain without difficulty considerable quantities introduced by means of a tube. A special tube has been devised for this purpose. It consists of a long flexible rubber tube, expanded at one end into a funnel. A mark is placed on the tube to show the distance to which it should be introduced. It is lubricated with vaseline, having been first washed with a warm antiseptic solution. The patient sits erect or lies on a couch with the head extended and the mouth open. The tube is passed through the mouth into the pharynx, being carried well back to the posterior wall to avoid the epiglottis. As it passes into the œsophagus gagging occurs, which is so great in some cases as to prohibit its use. In other cases it disappears after the tube has been used a few times, and many patients permit its introduction without hesitation.

The material most employed for this purpose is known as *Debove's powder*. It consists of very finely minced meat which has been dried in the oven at a temperature of 230° F. This meat when desiccated is reduced to a very fine powder having a reddish colour and the taste of roasted beef. It mixes readily with milk, broth, or gruel. An ounce is administered at first, but the amount may be rapidly increased to three or four ounces. The nutrient value of this powder is four times as great as that of fresh beef. The results of treating phthisis by forced feeding are reported as extremely good. It is very doubtful, however, whether methods of this character are to be commended except in extreme cases.

It sometimes happens that infants ill with serious acute diseases absolutely refuse all nourishment and stimulants. The effort to compel the child to take milk in small quantities results in the waste of a vast amount of strength, while little is accomplished. With the ordinary apparatus employed for stomach washing, several ounces of food may be quickly and easily introduced into the stomach. With children as with adults, food thus introduced is rarely vomited. Completely peptonized milk is the food employed, the quantity being larger than that given by the mouth. The process may be repeated once in four or five hours. This system of *gavage* has been for some time satisfactorily employed in the New York Infant Asylum in extreme cases of diphtheria, pneumonia, and gastro-intestinal disease.—FLOYD M. CRANDALL.

ALISMA.—A genus of the alismaceous family of the *Helobiæ*. *Alisma Plantago*, the water plantain, was formerly credited with various medicinal virtues, even that of curing rabies. It is now occasionally given for some supposed remedial action in lithiasis and other irritative affections of the urinary passages. The dose of the leaves, in powder, is 1 drachm; that of the root, ½ drachm. The fresh leaves are acrid and stimulating, and have been used as a vulnerary. The plant contains an acrid resin known as *alismin*.

ALKALIES.—Calcium, lithium, magnesium, potassium, and sodium are the bases certain compounds of which are included in this class. Those most commonly used are the

oxides and hydrated oxides and carbonates, but to them may be added the salts formed with acetic, citric, and tartaric acids, which, though not alkaline in reaction, become converted, after absorption, into the carbonates, and have a true alkaline effect upon the secretions of the body. In making use of the term alkali these latter salts will be excepted unless otherwise mentioned.

On account of the great affinity for water and high diffusibility of the oxides and hydrated oxides of calcium, potassium, and sodium, they are caustic and corrosive, and, if taken in sufficient quantities, are highly poisonous, causing deep erosions of the portions of the alimentary canal with which they may come in contact. The carbonates of potassium and sodium possess this property in a slight degree, and in large quantities cause decided irritation of the gastro-intestinal canal, while the same salts of calcium and magnesium are bland and unirritating. The salts of the organic acids in large doses may set up gastro-enteritis. Dilute acids, both mineral and organic, are the chemical antidotes in cases of poisoning, and to them should be added oily or fatty bodies and demulcent drinks, to prevent further action of the poisons as far as possible. In addition to the local effect, a weakened action of the heart, coldness of the surface of the body, collapse, and coma may supervene, not as the result of shock, but because of the physiological action of the alkalies. These complications must be combated by stimulants, hot applications to the surface, and opium.

In case of poisoning by acids or mineral salts the alkalies are the chemical antidotes, neutralizing the first and reducing the latter to the insoluble oxides. The absorption of alkaloids is somewhat retarded by them, but they are not to be regarded as being the only reliance in poisoning by those substances.

Caustic lime, potassa, and soda are largely used, either by themselves or in combination with other bodies, for the destruction of morbid growths, as applications to unhealthy raw surfaces, and for the opening of abscesses where the use of the knife is not advisable or desirable (cf. CAUSTICS).

If the administration of this class of bodies is too prolonged it will give rise to a true cachexia, resembling scurvy, in which there may be paleness, general emaciation, soft and spongy gums, and passive hæmorrhages from the different mucous surfaces. This condition is promptly relieved by ceasing to give the medicine and by the use of the vegetable acids, together with tonics, iron, and cod-liver oil. If the latter is given concomitantly with an alkali it will in a great measure prevent the occurrence of this cachexia. When taken into the system all the alkaline salts promote destructive metamorphosis, and hence in small doses are regarded as alteratives, and are also slight cardiac sedatives, especially the carbonates of potassium and sodium. Their most marked effects, however, are the diminution of normal or pathological alkaline secretions, the increase of acid secretions, and the neutralization of *undue acidity of the blood, urine, and other secretions* of the body. When they come in contact with a surface from which there is a normal or abnormal alkaline secretion, they diminish its quantity to a marked degree. On account of this property, weak solutions are beneficial in the *moist stage of eczema* and in *leucorrhœa depending upon a diseased state of the cervix uteri.* If it is desired to increase the amount of the gastric juice in cases where its secretion is scanty, as in *atonic dyspepsia*, alkalies given before eating will have the desired effect, provided there is no marked atrophy of the gastric glands. For this purpose they are best given combined with a bitter tonic. If administered after eating, the alkali will neutralize the acid of the gastric juice and retard the process of digestion. Neglect of these precautions leads in many cases to failure to relieve and brings great reproach upon the medical attendant. On the other hand, if there is an excess of the gastric juice or acid fermentation exists in the stomach, alkalies given after eating will be of benefit, but they act simply as palliatives and a permanent cure can not be expected by their use alone. (Cf. ACIDS.) Used for these last purposes, the carbonates are, as a rule, the least eligible salts when any amount of flatus exists, as the carbonic dioxide given off during their decomposition only aggravates the distress caused by large amounts of gas in the stomach. *Diarrhœa with acid, fluid, irritating stools* is easily cured by moderate doses, especially of the carbonates.

As a rule, the urine is rendered alkaline under their use, particularly when the carbonates, acetates, citrates, or tartrates are the salts selected; free uric acid is converted into soluble urates, and often uric-acid calculi are resolved. All conditions in which there is a considerable amount of free uric acid present in the urine are benefited by the use of alkalies, especially in children in whom there is painful micturition due to the irritation of the urethra by the sharp angles of the uric-acid crystals. In this connection it is to be borne in mind that if the carbonates are used they must be given on an empty stomach, as when taken during digestion they render the urine acid. *Cystitis with alkaline decomposition of the urine* is a condition aggravated by their use, as the greater the alkalinity of the urine, the more energetic is its decomposition. On the other hand, in *cystitis without decomposition, strangury, gonorrhœa*, and all conditions in which it is desirable to render the urine as unirritating as possible, their use is strongly indicated, and the salts of the organic acids are to be preferred. Alkaline baths render the urine alkaline and act as mild irritants of the skin. The desquamation of *measles* and *scarlet fever* is hastened and the danger of spreading the contagion lessened by these baths or by sponging with weak solutions. Where the skin is thick and tough, as on the hands and feet, much stronger solutions can be used, such as the tincture of green soap, and in some cases the soap itself. All

dry and scaly eruptions are, as a rule, benefited by such baths, to which, in case they prove irritating, bran or some other demulcent should be added. The *itching of lichen* and *of urticaria* is generally relieved by alkaline baths or applications, as also the pain from the *bites* or *stings of poisonous insects.* A poultice of hard-wood ashes often aborts phlegmonous inflammations, such as *boils, whitlows,* and *felons,* on account of the considerable amount of soda and potash they contain. Painting the affected surface with a strong solution of potash is sometimes effectual in these cases.

The alkaline carbonates are reputed to have the power of diluting the blood, and on that account of doing good to intemperate eaters and drinkers with *sluggish livers* and in cases of *hepatic* and *splenic dropsy.* When a somewhat prolonged course of treatment is desirable in such cases it is best carried out at one or another of the alkaline mineral springs, as the change of scene and the improved hygienic surroundings aid greatly. The individuals who receive the greatest benefit are the sedentary and plethoric and those who have resided in hot climates, and the conditions in which these waters are used with the best results are *lithiasis, chronic gastroduodenal catarrh, jaundice, engorgement of the hepatic and portal circulations, cirrhosis of the liver, gout, rheumatism, hepatic diabetes, atonic dyspepsia, and the disorders brought on by excesses in eating and drinking.*

In the treatment of *acute rheumatism,* to obtain the best results the alkalinization of the fluids of the body must be obtained as speedily as possible, the only precaution necessary being the avoidance of irritation of the stomach and intestines by too large doses. Under this treatment cardiac and arthritic complications rarely occur, and, if they do, are usually not so apt to lead to serious trouble. As the effect upon the heart is slightly sedative, alkalies are especially useful when any cardiac complication is suspected or expected. When this variety of treatment was first instituted 30-grain doses of potassium bicarbonate were given until defervescence or an amelioration of the pain occurred, but at the present time 1½ oz. of the same salt is administered in equally divided doses during the first twenty-four hours; as soon as alkalinity of the urine is established the quantity is diminished by one half, and as the pain and fever subside a further diminution of the dose is made until just sufficient to maintain the alkaline state of the urine is given. After the subsidence of the most acute symptoms from 10 to 20 grains of quinine sulphate are given every twenty-four hours. If constipation exists it must be relieved by cathartics. The addition of a drachm of lemon juice to each dose of the potash salt renders it more agreeable to take, and will also have a gentle laxative effect upon the bowels. It is to be noted that this method is more applicable to cases occurring in the plethoric and vigorous than in the anæmic and delicate. Sodium bicarbonate may be substituted if the potash is not obtainable, but is not so effective. Other uses of the alkalies will be more fully treated of under special heads. See CALCIUM, LITHIUM, MAGNESIUM, POTASSIUM, and SODIUM.—R. H. NEVINS.

ALKALOIDS.—The vegetable alkaloids, which are the only ones used in medicine, are proximate principles that combine with acids to form salts. They are found in a great number of plants, sometimes more than one in the same plant, and they usually constitute the active medicinal principle (cf. ACTIVE PRINCIPLES). On account of their more or less complete insolubility in water, the uncombined alkaloids are little used, being replaced by their more soluble salts.

ALKANET, formerly used medicinally, is now employed only as a colouring ingredient in pharmaceutical preparations.

ALLAMANDA CATHARTICA is an apocynaceous plant found in Guiana and Brazil. Its juice is milky and acts in small doses, from 8 to 10 drops, as a hydragogue cathartic. An extract made from the bark is also used as a cathartic, in doses of from 1 to 2 grains; but the best preparation is said to be an infusion of 2½ drachms of the leaves in a quart of water.

ALLSPICE.—See PIMENTA.

ALLYL.—A radicle, C_3H_5, found in combination in the oils of garlic and mustard. For *allyl tribromide* see TRIBROMHYDRIN.

ALMONDS.—The seed of *Amygdalus communis,* a tree indigenous to Asia Minor and Africa, and cultivated in the southern parts of Europe and the United States. The kernel of the almond seed is either sweet or bitter, and the varieties can be distinguished by their taste.

The almond was a highly esteemed medicament in the Hippocratic and Galenical eras, being used in emulsion in pulmonary affections, in leucorrhœa, in menstrual disorders, and as a diuretic.

The composition of both varieties is virtually the same except that the bitter almond contains amygdalin, which was the first glucoside discovered (1830). They contain a fixed oil, gum, sugar, and emulsin. *Amygdalin,* which is also contained in the leaves, seed, or bark of other trees than the almond, is a white substance in the form of transparent prismatic crystals, odourless, but with a bitter taste; it is soluble in water and in alcohol. When, in a watery solution, it is brought in contact with *emulsin,* an albuminous principle contained in both varieties of almonds, it is decomposed, and forms hydrocyanic and formic acids and a colourless, thin, volatile oil that has a peculiar odour and a burning taste. By itself, amygdalin is without effect upon the organism, 60 grains at a dose being innocuous. But if food containing emulsin has been taken, the amygdalin decomposes, and Liebig has shown that 17 grains of amygdalin will yield a grain of hydrocyanic acid.

An *emulsion of sweet almonds* is made by triturating ½ oz. of freshly blanched almonds with ⅛ oz. of gum arabic, 2 drachms of sugar, and ½ pint of distilled water. This is not only

an excellent demulcent in acute laryngeal and bronchial affections, in gastro-enteritis, and in cystitis or urethritis, but also nutritious and sedative. It may be administered *ad libitum.* The Ger. Ph. gives a *compound emulsion of almonds* made with 4 parts of sweet almonds, 1 part of hyoscyamus seed, and 64 parts of diluted bitter-almond water, which are made into an emulsion, and 6 parts of white sugar and 1 part of calcined magnesia are added. The hyoscyamus seeds make this an efficient bronchial sedative. The Fr. Cod. orders a *white linctus*, made by triturating 30 parts of sweet and 2 parts of bitter blanched almonds, with 20 parts of sugar and 120 parts of water; the emulsion is strained, and again triturated with 10 parts of sugar and ½ part of powdered tragacanth, and finally 10 parts of orange-flower water are added. The small amount of hydrocyanic acid contained in this linctus has but a slight action in bronchial irritation.

A *syrup of almonds* is made by triturating 140 parts of sweet and 40 parts of bitter blanched almonds with 100 parts of sugar and 30 parts of water until a smooth paste is made; this is mixed with 100 parts of orange-flower water and 200 parts of water, and strained with strong expression; 100 parts of water are added to the residue, and it is again expressed. In the strained liquid 100 parts of sugar are dissolved without heat, and enough water is added to make 1,000 parts. This syrup is an agreeable *menstruum for diuretic or expectorant mixtures.* In the Ger. Ph. a similar syrup is directed to be prepared by emulsifying 50 parts of sweet and 10 parts of bitter blanched almonds with 120 parts of water; 200 parts of sugar are added to 130 parts of the strained emulsion, and after boiling the mixture 10 parts of orange-flower water are added and the whole is mixed with 340 parts of syrup.

A bland and agreeable fixed *oil of almonds* is expressed from sweet almonds. It was formerly used to allay cough and bronchial irritation in doses of from 1 oz. to 9 oz. Externally it is employed where an unirritating oil is required, as in the *desquamation of scarlatina.*

From bitter almonds the *oil of bitter almonds* may be prepared by pressing the kernels between warm plates, macerating the cake with water, digesting the mixture, and then distilling the oil, 100 parts of which should contain nearly 13 parts of anhydrous hydrocyanic acid. This oil would be one of the best forms in which to administer hydrocyanic acid if its percentage of the acid was constant, and it could be used wherever the latter medicament was indicated. The dose is from ¼ to 1 drop.

A *spirit* or *essence of bitter almonds* is prepared by dissolving 10 parts of oil of bitter almonds in 800 parts of alcohol and adding enough water to make 1,000 parts. It may prove to be a more convenient preparation for administering the oil. The dose is ¼ to 1 teaspoonful.

Bitter-almond water is prepared by agitating 1 part of oil of bitter almonds with 999 parts of water, and filtering the mixture. This preparation is unreliable because the oil contains a variable amount of hydrocyanic acid. The Ger. Ph. provides that 12 parts of bitter almonds, freed from oil by a cold press, shall be mixed with 80 parts of water and 1 part of alcohol and allowed to stand for twelve hours in a well-covered retort; 11 parts of this are distilled off into a cool receiver containing 1 part of alcohol. The distillate is assayed for the amount of hydrocyanic acid, and it is diluted with a mixture of 1 part of alcohol with 5 parts of water, so that 1 part of hydrocyanic acid will be contained in 1,000 parts of bitter-almond water.

The various preparations of bitter almond are employed in cases in which hydrocyanic acid is indicated. (See HYDROCYANIC ACID.)

The *Index Catalogue of the Library of the Surgeon General's Office* mentions reports of thirty-nine cases of poisoning by bitter-almond preparations. Of these, the oil caused 28, the spirit 4, the almonds themselves 4, the water 2, and the emulsion 1.

Almond bread is made with sweet-almond meal, and is used as a substitute for wheat bread for diabetics.—S. T. ARMSTRONG.

ALNUS.—A genus of the *Cupuliferæ*, subfamily *Betulaceæ. Alnus glutinosa*, alder, was formerly official, and is used as an astringent, tonic, and diaphoretic. The bark, leaves, and young twigs are the parts employed. The bark contains *alnein*, which is highly astringent and has been recommended as a substitute for catechu. The fresh leaves have been used topically as an *antigalactic.* The dose of the powdered bark is 10 grains.

ALOES.—Though three varieties of aloes have been and are frequently used medicinally, the U. S. and Br. Ph's recognise but two, *Aloe barbadensis* and *Aloe socotrina.*

The Ger. Ph. recognises as official only *Aloe capensis* (cape aloes), the inspissated juice of the leaves of several species of *Aloe* coming from the Cape of Good Hope.

The Fr. Cod. recognises as official *aloès du Cap* (cape aloes) and *aloès des Barbades* (Barbadoes aloes).

Aloe barbadensis (Barbadoes aloes, Curaçoa aloes), is the inspissated juice of the leaves of *Aloe vera* and comes "in hard masses, orange brown, opaque, translucent on the edges; fracture waxy or resinous, somewhat conchoidal; odour saffronlike; taste strongly bitter" (U. S. Ph.).

Aloe socotrina (Socotrine aloes) is the inspissated juice of the leaves of *Aloe Perryi*, and comes "in hard masses, occasionally soft in the interior, opaque, yellowish-brown, orange-brown, or dark ruby-red, not greenish, translucent on the edges; fracture resinous, somewhat conchoidal. When breathed upon, it emits a fragrant, saffronlike odour. Taste peculiar, strongly bitter" (U. S. Ph.).

Aloe barbadensis or aloe socotrina may be employed in doses of from 1 to 5 grains as a laxative, or in doses of from 10 to 20 grains as a purgative, but 20 grains is to be considered a large dose. Owing to the impurities contained in commercial aloes, the purified aloes is invariably to be preferred for administration.

Decoctum aloes compositum (Br. Ph.), compound decoction of aloes, contains 4 grains of extract of Socotrine aloes in a fl. oz. The dose is from ½ to 2 fl. oz.

Enema aloes (Br. Ph.) consists of 4 grains of aloes, 1½ of potassium carbonate, and 1 fl. oz. of mucilage of starch.

Extractum aloes (U. S. Ph.), aqueous extract of aloes, formerly known as *extractum aloes aquosum*, is made from aloe socotrina. Its dose is from ½ to 5 grains.

The Br. Ph. gives an *extractum aloes barbadensis* and an *extractum aloes socotrinæ*, the dose of each of which is from 2 to 6 grains.

The Ger. Ph. also gives an *extractum aloës* made from cape aloes.

Aloes purificata (U. S. Ph.), purified aloes, is obtained from Socotrine aloes by a process of melting, the addition of alcohol, and straining, followed by evaporation and cooling. "The product is in irregular, brittle pieces of a dull-brown or reddish-brown colour and having the peculiar, aromatic odour of Socotrine aloes. It is almost entirely soluble in alcohol" (U. S. Ph.). The dose is from 1 to 5 grains. For a purgative effect, 10 grains may be employed. It is directed by the U. S. Ph. that those of the following preparations of aloes that are given in that work be compounded from aloe purificata.

Pilulæ aloes (U. S. Ph.), pills of aloes, contain 2 grains each of purified aloes and soap in each pill. One or two pills may be taken at a dose.

Pilula aloes socotrinæ (Br. Ph.), a pill mass of Socotrine aloes, consists of 16 parts of Socotrine aloes, 8 each of hard soap and confection of roses, and 1 fl. part of volatile oil of nutmeg. The dose is from 5 to 10 grains.

Pilula aloes barbadensis (Br. Ph.) is a similar mass made with Barbadoes aloes and with oil of caraway instead of oil of nutmeg. The dose is the same.

The *pilules d'aloès simples, pilulæ cum aloe*, of the Fr. Cod., contain each 1½ grain of powdered aloes.

The *pilules d'aloès et de savon, pilulæ cum aloe et sapone* of the Fr. Cod., contain 1½ each of aloes and soap in a pill.

Pilulæ aloes et asafœtidæ (U. S. Ph.), pills of aloes and asafœtida, contain purified (Socotrine) aloes, asafœtida, and soap, of each 1⅓ grain in each pill. The analogous preparation, *pilula aloes et asafœtidæ* of the Br. Ph., is made from Socotrine aloes and contains also confection of roses. The dose of the U. S. preparation is one or two pills; that of the British, from 5 to 10 grains.

Pilulæ aloes et ferri (U. S. Ph.), pills of aloes and iron, contain purified aloes, dried sulphate of iron, and aromatic powder, of each 1 grain in each pill. The dose is one or two pills.

Pilula aloes et ferri (Br. Ph.) consists of 1½ part of sulphate of iron, 2 parts of Barbadoes aloes, 3 of compound powder of cinnamon, and 4 of confection of roses. The dose is from 5 to 10 grains.

The *pilulæ aloëticæ ferratæ* of the Ger. Ph. correspond with the pilulæ aloes et ferri of the U. S. Ph., and contain equal parts of dried sulphate of iron and aloes.

Pilulæ aloes et mastiches (U. S. Ph.), pills of aloes and mastic, or the "Lady Webster dinner pills," contain purified aloes 2 grains, mastic and red rose, of each about ⅔ grain in each pill. The dose is one or two pills.

Pilulæ aloes et myrrhæ (U. S. Ph.), pills of aloes and myrrh, contain 2 grains of purified aloes, about 1 grain of myrrh, and about ⅔ grain of aromatic powder in each pill. The dose is one or two pills.

The *pilula aloes et myrrhæ* of the Br. Ph. contains 2 parts of Socotrine aloes, 1 part of myrrh, ½ part each of saffron and treacle, and a sufficiency of glycerin. The dose is from 5 to 10 grains.

The *pilules d'aloès et de gomme gutte* of the Fr. Cod., pills of aloes and gamboge, contain 1½ grain each of aloes and gamboge, with a small quantity of oil of anise as a flavouring agent and corrigent.

Tinctura aloes (U. S. Ph.) contains 10 per cent. of purified aloes. The dose is from 1 to 3 drachms.

Tinctura aloes (Br. Ph.) contains 11 grains of Socotrine aloes to 1 fl. oz. The dose is from 1 to 2 fl. drachms.

The *teinture d'aloès* of the Fr. Cod. is a 20-per-cent. tincture.

The *tinctura aloes* of the Ger. Ph. is made with 1 part of aloes to 5 parts of alcohol.

The *tinctura aloës composita* of the Ger. Ph., occasionally referred to as "*elixir ad longam vitam*," contains 6 parts of aloes, 1 part each of rhubarb, gentian, zedoary, and saffron, and 200 parts of diluted alcohol.

The *teinture d'aloes composée, tinctura de aloe composita*, of the Fr. Cod., is at times referred to as "*élixir de longue vie*." Its composition, like its name, is similar to that of the compound tincture of the Ger. Ph. It contains 2 per cent. of aloes.

Tinctura aloes et myrrhæ (U. S. Ph.), tincture of aloes and myrrh, elixir proprietatis, contains 10 per cent. each of purified aloes and myrrh. The dose is from 1 to 2 drachms.

The *wine of aloes* (*vinum aloes*) of the Br. Ph. is made with 1½ oz. of Socotrine aloes, 80 grains each of bruised cardamom seeds and coarsely powdered ginger, and 2 pints of sherry. The dose is from 1 to 2 fl. drachms.

The *suppositoires d'aloès* (*suppositoria cum aloe*) of the Fr. Cod., *aloes suppositories*, contain each about 8 grains of finely powdered aloes.

Given by the mouth, aloes, by virtue of its bitter taste, acts upon the stomach as a simple bitter and stomachic, increasing the appetite and promoting gastric digestion.

Upon the liver it acts as a true cholagogue, promoting the flow of bile and rendering it more watery.

The chief and most important action of aloes is seen in the large intestine, where it acts by increasing peristaltic action. Only in large purgative doses (20 grains) does it increase intestinal secretion; consequently the ordinary laxative dose of from 2 to 5 grains is followed by solid or pultaceous movements. This laxative dose may be accompanied in its action by some tormina. For the prevention of this an antispasmodic, especially belladonna, is often used

in combination. The larger purgative doses may cause rectal tenesmus, heat, fulness, marked symptoms of irritation, and even rectal catarrh. And thus, though in aloes we have one of the most useful of laxatives, its use as a purgative is not to be recommended, since we have at hand so many drugs that are its superiors both in producing purgation and in freedom from untoward effect.

In all doses aloes has a marked tendency to produce an increase of blood in the pelvic viscera, which, following the larger doses, may become pathological. From this action increased menstruation is often seen, and in the pregnant state abortion is not impossible. Frequency of micturition may also occur, and in some cases sexual excitement.

Applied to an open wound or a denuded surface, aloes is absorbed into the blood and exerts its usual action upon the large intestine in producing purgation. Given to a nursing mother, it will appear in the milk and produce purgation of the infant.

Aloes is a laxative of exceedingly slow action, ten to twelve hours usually being required for its effect. Thus it is usually to be given at bedtime, and, though a saline laxative given from six to eight hours after the administration of aloes well enhances its effect, it is to be employed usually uncombined with other laxatives.

Though seldom used in combination with other laxatives, aloes is quite as rarely used alone, for the addition of other remedies, not laxative, is usually advisable not only to correct its tendency to cause griping, but also both to enhance its action and more particularly to correct and to relieve those conditions of local or general atony and debility in which aloes finds its most useful application. As correctors of its tendency to gripe, belladonna and hyoscyamus are in general use, and as adjuvants to its action or remedies for the conditions in which it is employed, strychnine, nux vomica, asafœtida, mastic, iron, and myrrh. A pill in general use and one most valuable for the relief of constipation, the result of atony of the large intestine, is one containing $\frac{1}{8}$ grain each of extract of nux vomica and extract of belladonna and 2 grains of purified aloes.

Aloes, on account of its disagreeable taste, is almost invariably given in pill.

The contra-indications to the use of aloes will have been inferred from what has already been said. They are active abdominal or pelvic inflammation, pregnancy, genito-urinary disease, and hæmorrhoids if due to pelvic congestion. Moreover, its administration for the constipation of the plethoric is unwise.

Though the applications of aloes are somewhat varied, they, most of them, have as their basis the relief of *constipation* and its attendant ills, both pelvic and general, the result of atony of the colon and rectum. Thus, by far the commonest and most useful service it renders is in the relief of habitual constipation. For this purpose it is one of the most valuable drugs in our possession, and has the special merit of not requiring increase in dose as time progresses; and, though its use alone in such conditions may result in atony worse than before, yet if it is properly combined with the dietetic, hygienic, and medicinal remedies indicated in such cases for the permanent cure of the condition on which the atony depends, its dose may be steadily diminished until, cure resulting, the drug becomes no longer necessary. In such cases, too, it has the additional value of acting as a stomachic and thus relieving the gastric feebleness or even dyspepsia so often found in cases of subacute or chronic constipation. For this purpose only the smaller laxative doses are indicated, and they are more wisely given in pill.

In the constipation occurring in the weak and anæmic and in those of sedentary habits its use is most effective and it is to be given in connection with tonics and regulation of habits. Its employment with iron is in such cases very desirable, the aloes not only relieving the constipation incident to the disease, but preventing that resulting from the use of the iron. For such patients the pill of aloes and iron may be used, though it is perhaps more advisable to employ the iron in the usual way—namely, given after each meal, while the aloes is given in pill form and upon going to bed.

In habitual constipation it has been suggested that aloes be given in combination with strychnine and belladonna in suppository, but, while when thus given it is certainly active, the method is neither so thorough and convenient nor so rational as the administration by mouth. When enemata are employed for constipation the addition of tincture of aloes and myrrh (about 2 drachms) to the ordinary quantity of soapsuds is undoubtedly a means of increasing the activity and thoroughness of the enema.

In cases of *intestinal indigestion* resulting from the production of an insufficient quantity of bile and accompanied by dyspeptic symptoms with constipation, flatulence, dulness, drowsiness, and mental depression—those symptoms so carelessly classed under the name "bilious"—the use of aloes (especially in the form of the dinner pill, given in dose of one after each meal) is highly to be recommended. If flatulence is a prominent symptom the pill of aloes and asafœtida is probably the more effective form of administration.

In a similar way the constipation of hypochondriasis and melancholia receives marked benefit and relief.

In *anæmia* associated with constipation and accompanied by hysterical manifestations the pill of aloes and asafœtida (from three to six a day) is highly recommended.

As an *anthelminthic*, and especially for the expulsion of ascarides, aloes is often of service. For this purpose the pill of aloes is generally employed.

In *hæmorrhoids* aloes is by many supposed to be productive of harm, and, while it is doubtless true that if associated with active inflammatory conditions or pelvic congestions they would probably be aggravated, it is not to be doubted that in the absence of these conditions the drug is a most effective remedy in the cure of hæmorrhoids. It is certainly true, more-

over, that the vast majority of cases of hæmorrhoids are dependent upon passive congestion the result of constipation and deficient bile secretion, and in such cases aloes is directly indicated. Failure of relief in such cases may indeed occur, or even fancied aggravation, but it is much more reasonable to attribute the failure of success to the constipation for which the aloes was given rather than to the aloes itself. In causing piles, of which it has been accused, it certainly, if given in laxative doses, has no effect.

In *atony of the sexual apparatus in women*, as manifested in *amenorrhœa* or even in *menorrhagia*, the pill of aloes is of great service, and perhaps even of greater value is the pill of aloes and myrrh. Indeed, in amenorrhœa from this cause the pill of aloes and myrrh is by many regarded as a specific, and is to be given for several days preceding the period of expected menstruation. Should the amenorrhœa be dependent upon anæmia, as is so often the case, the pill of aloes and iron is to be preferred. The action of aloes in these cases has been supposed by some to be that of correcting the constipation generally present, but it seems more likely to lie in a stimulant effect directly exerted upon the endometrium.

Aloes has been recommended as a derivative in cerebral disorders, but where depletion is desired its use, even in purgative doses, is only irrational and useless.

Aloes is occasionally used in simple *catarrhal jaundice*, and, while no doubt it is of service in this condition, we certainly have in our possession remedies of much greater usefulness.

In *gonorrhœa* cures have been said to result from the administration of aloes in doses of from 2 to 3 grains, in pill, three times a day, but it would seem that the patients must have recovered rather in spite of the medication than on account of it, for in genito-urinary inflammations the use of aloes is not to be recommended. Tincture of aloes, diluted with an equal quantity of water or more, has been recommended as an injection in the later stages of gonorrhœa.

Locally, aloes in the form of a glycerole (made by evaporating the tincture and adding glycerin to it) may be advantageously applied to cracks and *fissures in mucous membranes* and to *bedsores*.—Henry A. Griffin.

ALOIN.—Aloin is official in the U. S. and Br. Ph's under the name of *aloinum*, and is "a neutral principle obtained from several varieties of aloes, chiefly Barbadoes aloes (yielding *barbaloin*), and Socotra or Zanzibar aloes (yielding *socaloin*), differing more or less in chemical composition and physical properties according to the source from which it is derived." It appears in "minute acicular crystals, or a microcrystalline powder, varying in colour from yellow to yellowish brown, odourless or possessing a slight odour of aloes, of a characteristic, bitter taste, and permanent in the air" (U. S. Ph.). The dose is from $\frac{1}{10}$ grain to 2 grains.

The uses of aloin differ in no marked way from those of aloes, and its title to superiority rests rather on its smaller dose and its supposedly less marked tendency to produce irritation and pelvic congestion than is seen from the use of aloes. As valuable combinations for laxative effect the following may be suggested:

℞ Aloini.................... gr. $\frac{1}{5}$;
Ext. belladon.............. gr. $\frac{1}{8}$;
Strychnin. sulph........... gr. $\frac{1}{60}$.
M. Ft. pil. No. 1.

℞ Aloini.................... gr. $\frac{1}{10}$;
Resin. podophylli.......... gr. $\frac{1}{10}$;
Ext. belladon.............. gr. $\frac{1}{10}$;
Ext. nuc. vom.............. gr. $\frac{1}{10}$.
M. Ft. pil. No. 1.

℞ Aloini.................... gr. $\frac{1}{10}$;
Ferri sulph. exsicc........ gr. j.
M. Ft. pil. No. 1.

Henry A. Griffin.

ALPHA-NAPHTHOL. — See under Naphthol.

ALPHOL is a preparation obtained by heating together sodium salicylate, sodium alpha-naphtholate, and phosphorus oxychloride, freeing the product from sodium chloride and sodium phosphate by treatment with water, and purifying by repeated crystallization from alcohol. Its therapeutic properties closely resemble those of salol. It is used as an antiseptic and antineuralgic, and is said to have given excellent results in *gonorrhœal cystitis* and in *acute articular rheumatism*. It is given in doses of from 7 to 15 grains or more, in capsules.

ALSTONIA.—A genus of apocynaceous trees of the East Indies. *Alstonia scholaris* furnishes Dita bark, and *Alstonia constricta* yields a bark having similar, if not indentical, medicinal properties, and known as Australian fever bark. The bark of these trees is astringent, tonic, and antiperiodic. It contains the alkaloids *alstonidine* and *alstonine*. *Alstonia scholaris* is official in the Fr. Cod. under the name *écorce de Dita*, and a tincture (made by macerating 1 part of the bark in alcohol, percolating, expressing, filtering, and adding enough more alcohol to make 5 parts of product) is used in France in daily amounts of from 1 to 2 drachms.

ALTERANTS, or **ALTERATIVES,** are remedies or measures which produce an alteration in the morbid processes of the tissues and tend to restore them to their normal state without their exact mode of action being known. They assist nutrition, enrich the blood, increase or decrease its plasticity, add to the number of the red corpuscles, improve the vital functions, aid in the absorption of exudations, and counteract the various toxæmic conditions, such as the malarial, syphilitic, tuberculous, and those due to chronic poisoning by metals. If their use is carried to an extreme, the nutritive and vital functions, instead of being improved, may be perverted. The action of astringents, etc., upon unhealthy surfaces has sometimes been termed alterative. The term is one which is going out of use rapidly, and as our knowledge of the actions of drugs increases it will probably be cast aside entirely.

The principal drugs, etc., included under this head are arsenic, iodine and its salts, iodoform, iodol, mercury, cod-liver oil, phosphorus and its compounds, sarsaparilla, guaiacum, electricity in its various forms, and massage.

R. H. Nevins.

ALTHÆA.—See Marsh Mallow.

ALUM.—Alums are double sulphates of the alkaline metals and the higher sulphates of the aluminum or the iron group. In pharmacy the name has been indifferently applied to aluminum and potassium sulphate, $Al_2K_2(SO_4)_4+24H_2O$ (potassium or potash alum) and to aluminum and ammonium sulphate $Al_2(NH_4)_2(SO_4)_4+24H_2O$ (ammonium or ammonia alum). The former alone is official in the U. S. and Ger. Ph's; both salts are official in the Br. Ph.

Alum occurs as large, colourless, octaedral crystals, or crystalline fragments, having a sweetish and strongly astringent taste. It is soluble in water and in warm glycerin, but insoluble in alcohol. It is obtained from alum shale, or by means of the direct combination of its constituents.

One hundred parts of alum placed in a shallow porcelain capsule so as to form a thin layer, heated over a sand bath until it liquefies, and stirred constantly until the aqueous vapour ceases to be disengaged, will give fifty-five parts of a dry white mass called *exsiccated alum* or *burnt alum.*

Externally, alum exercises no action on normal skin, but on a moist mucous membrane it produces whitening of the part and contraction of the fibres and blood-vessels. It coagulates the albumin in the discharges from ulcers, etc., and at the same time exercises an astringent action on the tissues, decreasing secretion and causing contraction of the capillaries. Internally, it produces vomiting in large doses, and is irritant and purgative; in small doses it is an astringent for the stomach and intestines. As an *emetic,* it has been used in cases of croup, in doses of a drachm, repeated every fifteen minutes until vomiting occurs. In such doses, it is well to dissolve it in syrup.

Externally, it is used as a mild caustic to destroy *exuberant granulations.* In small discs, containing $\frac{1}{250}$ of a grain each, it is applied to the eye in *granular lids,* or a cone of alum, mounted in a wooden case, is applied to the granulating surface. One part each of alum, copper sulphate, and potassium nitrate, with $\frac{3}{50}$ part of camphor, are fused together and run into a mould, forming an aluminate of copper; this is used as a stronger stimulant to granulating surfaces. A solution of from 2 to 5 grains to the ounce may be used as a collyrium. A favourite application to granulation tissue formerly was *alum curd,* made by mixing powdered alum and the white of egg. It forms a cataplasm that has been recommended for *chilblains.*

Alum finely powdered or in solution has been used as a styptic, especially in *hæmorrhages from mucous membranes.*

In *colliquative sweats,* sponging the body with alum water, or giving a bath in an alum solution, has been recommended to restore the tone to the skin.

In *diphtheria* and *croup* insufflation of powdered alum, or nasal and faucial irrigation with an alum solution, has been highly recommended.

In *catarrhal affections* of the mucous membranes a solution of from 5 to 30 grains of alum to the ounce of water will reduce the discharge.

The late Sir Morell Mackenzie recommended powdered alum applied by means of a pharyngeal spatula as a most effective application for *enlarged tonsils.*

The administration of alum in *lead colic,* in amounts of from 60 to 120 grains a day, has caused a marked amelioration in the symptoms and relieved the constipation.

It has been recommended in *dysentery* and in *diarrhœa,* in pills in amounts of from 5 to 30 grains a day, but it is inferior to enteroclysis and diet for the relief of these diseases.

Alum whey, prepared by boiling 2 drachms of powdered alum with a pint of milk and straining, given in wineglassful doses or less, has been administered in *diabetes* (successfully and unsuccessfully), in the *diarrhœa of typhoid fever,* in *chronic bronchitis,* and in *whooping cough* to restrict the secretion of mucus.

A *glycerin of alum* is official in the Br. Ph. One ounce of powdered alum is stirred and heated with 5 fl. oz. of glycerin. This has the astringency of the glycerite of tannin, but is more irritating than the latter, and, unlike it, does not stain linen.

Dr. C. H. R. Harrison has proposed a "tannate of alum" for the treatment of obstinate *gonorrhœa* and *gleet.* He injects it, in the strength of 5 grains to 1 oz. of water, several times daily.—S. T. Armstrong.

ALUMINIUM, OR ALUMINUM, AND ITS SALTS.—Aluminum is a bluish-white metal that, while hard, is malleable and ductile, very light and sonorous, and a good conductor of electricity. It is unaffected by air or oxygen, but combines directly with boron, bromine, chlorine, iodine, and silicon. Hydrochloric acid, as a gas or in solution, attacks it with the evolution of hydrogen and the formation of aluminum chloride. It dissolves in alkaline solutions with the formation of aluminates. It is exceedingly abundant in clay as a silicate, and by several patented or secret processes it is obtained therefrom. The only report of its internal administration is that of A. Joux, who, in 1856, administered the powdered metal in doses of 3 grains six times a day, and applied it externally in an ointment of a strength of 1 to 25, in a case of recurrent cancer of the spermatic cord. No benefit resulted from its use. It is used in the manufacture of the handles of surgical instruments, and, on account of its lightness, it is an excellent material for permanent splints, such as those used in chronic diseases of the vertebræ.

[*Aluminum boroformate* occurs in the form of pearly scales crystallized from a solution prepared by saturating with freshly precipi-

tated and well-washed alumina a solution of 2 parts of formic acid and 1 part of boric acid in 6 or 7 parts of water. It is said by J. Martenson to be mildly *antiseptic* and *astringent* (*Pharm. Jour. and Trans.*, Dec. 1, 1894, p. 433)].

Aluminum hydrate, $Al_2H_6O_6$, is prepared by decomposing a solution of an aluminum salt by an alkali or alkaline carbonate. It is a light, white, amorphous powder, odourless and tasteless, insoluble in water, but soluble in acids and in fixed alkalies. It is feebly astringent, and has been used externally in skin diseases.

Aluminum sulphate, $Al_2(SO_4)_3$, is obtained by dissolving aluminum hydrate in sulphuric acid or by heating clay with sulphuric acid. It crystallizes, with difficulty, in thin flexible plates; it is soluble in water, but insoluble in alcohol; it has a sweetish and afterward astringent taste. Injected into the blood, it produces strong contraction in the pulmonary and systemic capillaries. It has been used, in saturated solutions, as an *antiseptic* in diseases of the nose, throat, vagina, and uterus. In weaker solutions it is used as a *lotion for ulcers* and for *fœtid vaginal discharges*.

Mentel published, in 1857, a formula for a *benzoinated solution of aluminum*, prepared by dissolving 1,000 parts of pure aluminum sulphate in 2,000 parts of water. This solution was saturated with recently prepared gelatinous aluminum hydrate. To the solution 100 parts of bruised amygdaloidal benzoin were added, the mixture was kept at a temperature of from 140° to 176° F., with agitation from time to time, and evaporated until the density was 1·26 at 59° F., when it was filtered and cooled. It was used in *fetid leucorrhœa*.

The Ger. Ph. provides for a *solution of acetate of aluminum* (*liquor aluminii acetici*). It is made by dissolving 300 parts of aluminum sulphate in 800 of water and 360 of acetic acid, and gradually adding 130 of precipitated calcium carbonate triturated in 200 of water. The mixture is allowed to stand for twenty-four hours, and is then strained and filtered. It is used in a 2½-per-cent. solution as a disinfecting wash in wounds and chronic granulating surfaces, and as an injection in gonorrhœa. Gauze impregnated with a 5-per-cent. solution is used as a surgical dressing.

There is a non-official German preparation, *liquor aluminii acetici glycerinatus*, consisting of a mixture of 84 parts of the solution of acetate of aluminum, 4 parts of dilute acetic acid, and 12 parts of glycerin. It is used as a *local antiseptic*.

Aluminum chloride, Al_2Cl_6, is prepared by passing chlorine gas over a mixture of aluminum oxide and carbon heated to redness, or by heating clay in a mixture of gaseous hydrochloric acid and vapour of carbon disulphide. It crystallizes in colourless, hexagonal prisms that are fusible, volatile, deliquescent, and very soluble in water and in alcohol. Gowers states that in doses of from 2 to 4 grains several times a day he has found it of distinct advantage in relieving the *pain of tabes dorsalis*.

A *solution of aluminum chloride* is prepared by the double decomposition of aluminum sulphate and barium chloride. It is a straw-coloured, inodorous liquid that has an astringent taste and an acid reaction. It possesses strong antiseptic properties. A weaker solution, of darker colour on account of the presence of iron perchloride, is prepared by the double decomposition of aluminum sulphate and calcium chloride; it is sold under the proprietary name of *chloralum*.

An Italian pharmacist, G. Tarozzi, has made a *sulphophenate of aluminum and potassium* by the decomposition of sulphophenate of barium with potash alum. It occurs in unctuous, hygrometric crystals that have a pronounced styptic taste and the odour of phenic acid. It is a *hæmostatic*, and has been used as a *disinfectant* for various suppurating surfaces.

Dr. W. C. Wade reported in 1888 that he had employed as *antiseptics* the *sesquisulphite* and the *persulphite of aluminum*. The former is made by adding a solution of 10 parts of potash alum to 8 of sodium sulphite, and carefully washing and drying the precipitate. It is an insoluble white powder. The persulphite is made by adding sulphuric acid to the undried sesquisulphite, making a solution and crystallizing it without heat; it is soluble. No dangerous effects followed the administration of either of these salts in doses of 30 grains.

S. T. Armstrong.

ALUMNOL.—This substance, thought to be an aluminum naphtholsulphonate, is a whitish powder, but slightly if at all hygroscopic, freely soluble in cold water and still more freely in hot water, moderately soluble in glycerin, sparingly soluble in alcohol, and insoluble in ether. It was discovered by Filehne and introduced into dermatological practice by the German physicians as an astringent and antiseptic. Although it forms a precipitate with albumin, the precipitate is soluble in an excess of albumin, so that an abundant morbid secretion does not prevent it from reaching the underlying diseased surface. A 1-per-cent. solution has been used with advantage as an injection in *gonorrhœa*, and a 10-per-cent. solution for the irrigation of *wounds* and *abscesses*, as a dressing for *venereal sores* and other *ulcers*, and as an application in various superficial inflammatory and parasitic skin diseases, such as moist *eczema*, *psoriasis*, *acne*, *urticaria*, and *favus*. A 4-per-cent. solution has been found effective in checking *lacrymation* and *epiphora*. Owing to its unirritating quality and its solubility in purulent discharges, it may be used by insufflation of the powder in situations, such as the middle ear, where most other astringents used in that manner would clog the perforation of the drum membrane.

ALVELOZ.—The milky juice, *leite d'alveloz*, of this South American plant (supposed to be *Euphorbia heterodoxa*), preserved for transportation by the addition of salicylic acid, is of a syrupy consistence, soluble in ether and in chloroform, and miscible with fixed oils. It is a powerful irritant and mild caustic, said to produce profuse suppuration when applied to raw surfaces, and to have proved very beneficial as an application to *cancerous* and *syphi-*

litic ulcers. A resin, obtained by precipitating the juice with water, has been used in the form of a 3-per-cent. ointment made with vaseline.

AMANITA MUSCARIA.—See under Agaric.

AMANITINE.—See Muscarine.

AMARA.—See Bitters.

AMBER.—A fossil resin, the *succinum* of the Fr. Cod., that is found on the southern shores of the Baltic Sea, and also in fossil beds in the interior of Europe, Asia, and North America. It occurs in yellow, red, or white masses, clear or opaque, that are quite brittle. It is insoluble in water, and only partly soluble in alcohol or ether, but dissolves freely in chloroform. When rubbed briskly it becomes negatively electric. It melts at 550° F., and in burning emits an agreeable aroma.

Dry distillation of amber yields succinic acid (*q. v.*) and oil of amber. The latter is a yellowish, transparent liquid having a peculiar pungent odour, and a hot, acrid taste.

Amber itself is not used medicinally, but it is a popular superstition in some parts of the world that wearing a necklace of amber beads will prevent diphtheria and control functional convulsive diseases.

The *oil of amber* (*oleum succini*), which is often adulterated with kerosene or turpentine oil, is an irritant when applied externally. Given internally, it has been credited with stimulant and antispasmodic properties, and it has been administered in the treatment of *gout* and *rheumatism.* In large doses it has been taken to produce criminal abortion. It has been recommended in *whooping-cough* and in *infantile convulsions,* and in the latter affection it is also applied externally along the spine.

Formerly the oil was official in the U. S. and Ger. Ph's, but on account of its insignificant therapeutic properties it has been omitted from the last editions of these works. The dose of the oil is from 5 to 15 drops, in a capsule.—S. T. Armstrong.

AMBLOTICS.—See Abortifacients.

AMBROSIA.—Two species of this genus of senecionideous plants—*Ambrosia trifida* and *Ambrosia artemisifolia,* ragweed, hogweed—are esteemed in the Southern States to be tonic and astringent and especially to act effectively in checking *epistaxis,* the nasal passages being plugged with the leaves. The pollen is thought to be one of the chief excitants of so-called hay-fever. Ambrosia may be given freely in infusion or decoction of from 10 to 15 parts in 500 of water.

ÂME.—A Japanese preparation of malt, said to be more readily digested than most products of the sort.

AMIDOBENZENE.—See Aniline.

AMIDOPROPIONIC ACID, or *alanin,* $CH_3.CH(NH_2).CO_2H$, is a sweetish, crystalline substance obtained by the prolonged heating of aldehyde-ammonia with hydrocyanic and hydrochloric acids. Its compound with mercury, *amidopropionate* or *alaninate of mercury,* is a crystalline powder soluble in 3 parts of water. It is an eligible mercurial for subcutaneous use, as it does not cause irritation at the site of the injection. In the treatment of *syphilis* it may be used in daily amounts of from $\frac{1}{12}$ to $\frac{1}{4}$ of a grain.

AMMI, or *ajowan* (the *ammi officinal* of the Fr. Cod.), is the fruit of *Ptychotis Ajowan* and of various other allied Oriental umbelliferous plants. It is a carminative ranking with anise. A volatile oil distilled from it, which smells like thyme, is given in doses of from 1 to 3 drops, on sugar.

AMMONIA.—A transparent colourless gas, NH_3, that has an acrid taste, an extremely pungent smell, and an intensely alkaline reaction. It may be prepared by the union of nascent hydrogen with nitrogen, or by the spontaneous or artificial decomposition of organic matter containing nitrogen, or by heating a mixture of dry slaked lime with ammonium chloride, or by heating a solution of ammonium hydrate. The gas liquefies at −40° F., forming a colourless, mobile fluid used in making artificial ice. It is very soluble in water, 1 volume of the latter, at 59° F., dissolving 727 volumes of ammonia.

Physiological Action.—It diminishes the excitability of the muscular system and lessens its capacity for work; it increases the functional activity of the spinal cord; it stimulates the vaso-motor centres, and thus raises the blood-pressure; it stimulates the vagus and the respiratory centres, but when inhaled it may arrest respiratory movements by irritating the nasal branches of the fifth nerve. In moderate doses it increases blood-pressure and diminishes secretion, thus acting as a stimulating expectorant. By its stimulating action on the vaso-motor centre, and its action on the heart, like that of alcohol, it is a most important cardiac stimulant, though in toxic doses it produces cardiac paralysis that is preceded by violent convulsions, respiratory disturbances, and lowering of the temperature.

In man slight traces of free ammonia are found in the urine, the quantity being increased when putrefaction sets in.

Ammonia water (*aqua ammoniæ* [U. S. Ph.], *liquor ammoniæ* [Br. Ph.], *liquor ammonii caustici* [Ger. Ph.]) is an aqueous solution containing 10 per cent. by weight of the gas. It is a colourless liquid, transparent, and possessed of the odour and taste of the gas. It has a lower freezing point than distilled water.

A *stronger ammonia water* (*aqua ammoniæ fortior* [U. S. Ph.], *liquor ammoniæ fortior* [Br. Ph.]) is made that contains according to the U. S. Ph. 28 per cent., according to the Br. Ph. 32·5 per cent., of the gas.

The vapour of ammonia water, when inhaled, stimulates the nasal branches of the fifth nerve, thus reflexly exciting the vaso-motor centre and consequently raising the blood-pressure, and so relieves *syncope* or *shock.* Such inhalations may be administered in *opium narcosis* or in *cardiac depression* caused by sedatives, but, if too strong a solution is used or the inhalations are continuous or too prolonged, they may cause inflammation of the

air-passages. Externally, it is a *counter-irritant*, acting as a *rubefacient* when confined in contact with the skin; either alone or in the form of a liniment, it may be used locally for *neuralgia* or *rheumatism*. It may be applied pure, by means of a compress or on a bit of absorbent cotton placed in a shallow receptacle, like a watch-glass, which is to be held firmly against the part, so as to prevent evaporation, to produce *vesication*. It has been applied to *insect-bites* and *stings* to neutralize the acid poison.

In large doses ammonia water is a violent corrosive poison, and the fumes may cause suffocation during swallowing by gaining access to the air-passages. When it has been swallowed accidentally, either vinegar or lemon juice should be administered at once as an antidote.

It may be injected hypodermically in a dilution of 1 part to 3 parts of water into the puncture made by a *snake-bite*, and in the same strength it may be administered intravenously to prevent *collapse*. In collapse or heart failure due to other causes, from 10 to 60 drops of ammonia water, diluted with from 1 to 8 drachms of sterilized distilled water, may be injected into a vein with great benefit.

Ammonia water or some of its preparations may be used to stimulate the gastric secretion, especially in patients in whom it is undesirable to lessen urinary acidity. It is often useful in those forms of *gastric fermentation* in which the stomach is distended with gas. In *gastric superacidity* from 1 to 5 drops of the ammonia water, taken in a small quantity of water, will neutralize the acid. The aromatic spirit of ammonia is a more tasteful remedy for the latter condition, and its administration is also indicated in that form of *headache* caused by gastro-intestinal indigestion. In *acute alcoholism* or *alcoholic narcosis*, after gastric lavage or emesis produced by apomorphine, 10 drops of diluted ammonia water may be administered *per os* every half hour to avert the toxic effects of the alcohol. In such conditions it may also be appropriately given intravenously.

Sir B. W. Richardson has called attention to the *antiseptic* action of ammonia water, and Dr. Gottbrecht has confirmed that report by bacteriological investigations, finding that animal matter placed in a 5-per-cent. solution of ammonia was free from putrescence after nearly two years.

Ammonia water is used in the preparation of ammonia, or volatile, liniment (*linimentum ammoniæ* [U. S. Ph., Br. Ph.], *linimentum ammoniatum*, seu *ammoniacale*, seu *volatile* [Ger. Ph.]) by being mixed and agitated with the following ingredients:

	U. S.	Br.	Ger.	Fr.
	C. c.	Parts by vol.	Parts.	Grammes.
Ammonia water	350	1	1	10
Alcohol	50	..	..	
Cotton-seed oil (olive oil, Br. Ph., Ger. Ph.)	600	3	3	
Poppy oil	....	..	1	
Sweet-almond oil	....	..	..	90

It is a stimulating application for local pain.

In France and Germany *camphorated ammonia liniment* (*linimentum ammoniato-camphoratum*) is official. It is prepared by mixing and agitating.

	Ger.	Fr.
Camphorated oil	3 parts.	90 grammes.
Poppy oil	1 part.	
Ammonia water	1 "	10 "

Linimentum ammoniato-phosphoratum is a non-official German preparation consisting of phosphorated oil, 25 parts; ammonia water, 8 parts; turpentine oil, 1 part.

Linimentum saponato-ammoniatum is another unofficial German preparation consisting of 1 part of brown soap dissolved in 30 parts of water and 10 parts of alcohol, and mixed with 15 parts of ammonia water.

The stronger water is used to prepare *spirit of ammonia* (*spiritus ammoniæ* [U. S. Ph.], *liquor ammonii caustici spirituosus* [Ger. Ph.]), an alcoholic solution containing 10 per cent. by weight of the gas. It is a colourless liquid having an alcoholic and ammoniacal odour. It is rarely used internally.

Spirit of ammonia may be used in place of the aromatic spirit, in doses of from 5 to 30 drops. It is sometimes useful in *post-febrile asthenic conditions*.

An *aromatic spirit of ammonia* (*spiritus ammoniæ aromaticus* [U. S. Ph., Br. Ph.]) contains the following ingredients:

	U. S.	Br.
Ammonium carbonate	34 grammes.	4 oz.
Ammonia water	90 c. c.	
Stronger ammonia water	....	8 fl. oz.
Oil of lemon	10 c. c.	$6\frac{1}{4}$ fl. drachms.
Oil of lavender flowers	1 "	
Oil of nutmeg	1 "	$4\frac{1}{4}$ fl drachms.
Alcohol	700 "	6 pints.
Distilled water, enough to make	1,000 "	3 "

Its dose is from 20 to 60 drops, in water.

The Br. Ph. prescribes a *fetid spirit of ammonia* that is prepared by macerating $1\frac{1}{2}$ oz. of asafœtida in 2 fl. oz. of alcohol for twenty-four hours, when the spirit is distilled off and the product mixed with 2 parts of the stronger water of ammonia, and then enough alcohol added to make 1 pint. The fetid spirit of ammonia may be administered in *hysterical conditions* and in *gastro-neuroses*, as well as in other states in which asafœtida is indicated. The dose is from 15 to 60 minims, in water.

The Ger. Ph. orders an *anisated spirit of ammonia* (*liquor ammonii anisatus*) that is a mixture of 5 parts of ammonia water with a solution of 1 part of oil of anise in 24 parts of alcohol.

There is an unofficial German preparation, *liquor ammonii aromatico-æthereus*, consisting of a mixture of 4 parts of liquor ammonii vinosus, and 1 part each of aromatic tincture and spiritus æthereus. It is used as a carminative in doses of from 15 to 20 drops. The *liquor ammonii vinosus* is a mixture of 1 part of ammonia water with 2 parts of alcohol.

Any of the preparations of ammonia water are useful to stimulate the intestine, and to facilitate the expulsion of gas in flatulence. They will be found to be serviceable in the *flatulence* and *colic* of children.
S. T. Armstrong.

AMMONIAC, the *ammoniacum* of the pharmacopœias (the *gomme ammoniaque* of the Fr. Cod.), is a gum-resin that exudes from the trunk of a Persian umbelliferous tree, *Dorema Ammoniacum*, at points where it has been punctured by beetles. It is soluble in alcohol, and forms a milky emulsion (*lac ammoniaci*) when triturated with water. Ammoniac is used internally as a stimulating *expectorant*, in doses of from 10 to 30 grains, in powder, pill, or emulsion. Ammoniac emulsion is official in several pharmacopœias. The *emulsum ammoniaci* of the U. S. Ph. contains 1 oz. and 180 grains of ammoniacum in 33 fl. oz. and 6½ fl. drachms of the mixture; the *mistura ammoniaci* of the Br. Ph., 1 oz. of the gum in 64 fl. oz. of water. Ammoniac is in some repute as a resolvent, and figures in various compound plasters, notably the *emplastrum ammoniaci cum hydrargyro.*

AMMONIUM.—Compounds of ammonium are formed when ammonia gas and an acid gas come together without the liberation of hydrogen, or by the direct union of a diatomic anhydride with dry ammonia. When heated to redness they are volatilized without leaving any residue, unless the acid is not volatile.

In man, small quantities of ammonia gas are found in the putrefactive processes that occur in the alimentary canal, but it soon enters into combinations to form salts or organic compounds. Of the ammonium salts, minute traces of ammonium chloride are found in the urine, as is the case with ammonium urate and ammonio-magnesic phosphate. Ammonium carbonate is formed from urea in decomposing urine.

Physiological Action.—While the action of ammonium is materially modified by the acid radicle with which it is combined, all its salts have an action on the spinal cord, the motor nerves, and the muscles, some salts affecting the cord first, others the motor nerves. For example, toxic doses of the bromide produce hyperæsthesia with atonic spasm that eventually passes into tetanus; ammonium chloride will produce tetanus; ammonium iodide produces progressive paralysis, the brain apparently being affected before the spinal cord, but there is no tetanus; ammonium phosphate produces paralysis without convulsions; ammonium sulphate produces symptoms similar to those caused by the bromide, but rarely is tetanus present.

Dr. T. Lauder Brunton aptly suggests that these salts form a series at one end of which the members stimulate the spinal cord, and have no marked paralyzing action on the motor nerves, while those at the other end have no marked stimulating action on the cord, but paralyze both it and the motor nerves. Many of these salts stimulate the vaso-motor centres.

The chloride and the carbonate of ammonium have been found to increase glycogenesis, and both the phosphate and the benzoate are powerful hepatic stimulants, increasing the secretion of bile.

In the articles which immediately follow, only those ammonium salts will be treated of that owe their medicinal properties mainly or largely to the base; for the others, see under Arsenic, Benzoic Acid, Bromine, Iodine, Phosphorus, Valerian, etc.—S. T. Armstrong.

AMMONIUM ACETATE, $(NH_4)C_2H_3O_2$, is formed by saturating acetic acid with ammonia gas or with ammonium carbonate. It is a white, odourless, soluble substance that crystallizes in large needles. It is rarely used in the natural state.

Solution of ammonium acetate, spirit of Mindererus (*liquor ammonii acetatis* [U. S. Ph., Br. Ph.], *liquor ammonii acetici* [Ger. Ph.]), is made by adding 5 parts of translucent pure ammonium carbonate to 100 parts of diluted acetic acid and stirring gradually until dissolved. The British preparation is made by mixing 1 fluid part of the *liquor ammonii acetatis fortior* (Br. Ph.) and 5 fluid parts of water.

In the Ger. Ph. the solution of ammonium acetate is prepared by mixing and heating in a porcelain vessel 10 parts of ammonia water with 12 parts of acetic acid; this is neutralized with ammonia water, filtered, and water added to bring the specific gravity to 1·032. It is a clear liquid, of a mildly saline taste and acid reaction. It should be freshly prepared, because its acid becomes decomposed and ammonium carbonate is generated. It is used as a diaphoretic and diuretic, and Ringer thinks its action is increased by combination with other remedies of the same class; both Hare and Wood regard it as very feeble in its action. It is frequently used in febrile and inflammatory affections, such as the *exanthemata*, *acute catarrh*, *influenza*, and *infantile coryza*, and in *headache* consequent upon gastric derangement. Dr. George Harley recommends it in large doses in cases of *delirium due to "biliousness."* Dr. A. T. Thompson has applied it locally in *porrigo* of the scalp, and it has been used as a lotion in *sprains*, *bruises*, and *glandular enlargements*. It is a mild diuretic and does not irritate the kidneys, but increases both the water and the solids excreted. The dose is from 1 to 8 drachms, in water, repeated every three or four hours.

The British pharmacopœia provides a *strong solution of ammonium acetate* (*liquor ammonii acetatis fortior*) that is prepared by gradually adding 17½ oz. of crushed ammonium carbonate to 45 oz. of acetic acid, then adding more acid until a neutral liquid results, and finally adding sufficient distilled water to yield 3 pints of product. The dose of this solution is from 25 to 75 minims, but its principal use is in the preparation of solution of acetate of ammonium.—S. T. Armstrong.

AMMONIUM BIBORATE. —See Ammonium Borate.

AMMONIUM BICARBONATE, $(NH_4)HCO_3$, is produced by exposing powdered official ammonium carbonate to the air, or by heating its solution, or by keeping it under a

bell glass over sulphuric acid and slaked lime, or by treating 1 part of the carbonate with 2 parts of water. All these processes decompose the carbonate into the bicarbonate, carbon dioxide, and ammonia. The bicarbonate is a white powder that has no ammoniacal odour when dry, and possesses a cooling, saline taste. It is soluble in water in the proportion 1 to 8. It has a less caustic taste than the carbonate and is more palatable, being especially adapted for effervescing draughts. It may be used as an *antacid* instead of sodium bicarbonate. The dose is from 3 to 10 grains.
S. T. Armstrong.

AMMONIUM BORATE, $2(NH_4HB_2O_4)3H_2O$, is formed by dissolving boric acid in ammonia water and heating until the ammonia excess evaporates. It occurs in semitransparent crystals having an alkaline taste and reaction. It is soluble in water. It is said to be efficacious in *cystic catarrh*, especially that associated with calculus, and in *renal colic*, uric acid and earthy phosphates appearing in the urine in great quantities. The dose is from 10 to 20 grains, every hour.

Professor Lashkevich reported in 1887 that he had found this salt of great value in the treatment of *phthisis*. It decreases expectoration and diminishes pyrexia. The dose is 5 grains, three times a day, with codeine or some other sedative.—S. T. Armstrong.

AMMONIUM CARBAZOTATE, *ammonium picronitricum, picrate of ammonium*, $C_6H_2(NO_2)_3ONH_3$, is a compound of ammonium and picric acid. Internally, it diminishes the strength of the pulse, and in large doses brings on heaviness and causes cephalalgia or even delirium. It is eliminated by the kidneys. In its physiological action it closely resembles quinine. Dr. Dujardin-Beaumetz states that it is very efficacious in *intermittent fever*. The suppression of the paroxysms may be obtained, he says, by the use of from $\frac{1}{5}$ to $\frac{3}{5}$ of a grain daily, and no bad effects are produced.

Mr. H. M. Clark (*Lancet*, 1887, i, p. 366) states that he used this drug during four years and a half in 10,000 cases of *malarial disease* of an intermittent type, and in 9 cases only did it fail to cure. He gave it in doses of from $\frac{1}{2}$ to $1\frac{1}{2}$ grain four or five times a day, in pill. He states that it is useless in remittent fever. In therapeutic doses it produces no unpleasant effect—headache, deafness, tinnitus, gastric disturbance, or nausea.

On account of its explosive effect it should be dispensed with caution.

No report regarding its efficacy has been made since the custom of confirming the diagnosis of paludal fevers by searching for the *Hæmatozoon* of Laveran has prevailed.
S. T. Armstrong.

AMMONIUM CARBONATE, *or sesquicarbonate, ammonii carbonas* (U. S. Ph., Br. Ph.), *ammonium carbonicum* (Ger. Ph.), *sal volatile*, Preston salts, $(NH_4)_4H_2(CO_3)_3$, is prepared by heating a mixture of ammonium chloride and calcium carbonate and condensing the product. Ammonium sulphate may be substituted for the chloride. Ammonium carbonate occurs in white, translucent masses that become opaque and friable on exposure to air. It has a pungent odour, a sharp taste, and an acid reaction.

As it occurs in commerce it consists of ammonium bicarbonate (acid carbonate) and carbamate. It is soluble in cold water, but is decomposed by hot water with the elimination of ammonia and carbonic-acid gas. When it is added to alcohol the carbamate is dissolved, leaving ammonium bicarbonate. It volatilizes on being heated.

Ammonium carbonate neutralizes the gastric acids and is a useful *antacid*, but, administered in large doses, it is incompletely neutralized, and it may so stimulate the gastric mucous membrane that vomiting will be produced. It possesses in a lesser degree the stimulating properties of ammonia, and its use is indicated where an ammonium salt is to be administered continuously. It excites the action of the skin, kidneys, and bronchial glands.

Röhmann found that it increased the formation of glycogen; this is not considered the result of its alkalinity, because sodium carbonate will not act in this manner, but it is believed that ammonia and a carbohydrate entering the liver together may form a new compound that will split into glycogen and a nitrogenous product, such as urea.

Schröder's recent experiments indicate that ammonium carbonate is one of the urea precursors. After nephrectomy in a dog there is a fourfold urea increase, but blood mixed with ammonium carbonate and passed through the excised kidney or through the lower-limb muscles shows no urea increase, while if the mixture is passed through the liver there is an increased quantity of urea, although blood so passed without this ammonium salt shows slight, if any, increase of urea. The administration of ammonium salts with the food increases the excretion of urea. Pathologically, these conclusions are supported by the fact that in hepatic cirrhosis, in which the liver-cells are partly destroyed by the connective-tissue proliferation, urea in the urine is diminished while ammonia is increased.

Ammonium carbonate is an irritant when administered internally in large doses, and advantage is taken of this fact when an *expectorant* re-enforced by an emetic is desired in severe cases of *chronic bronchitis* in which there are pronounced dyspnœa, feeble circulation, and great depression in consequence of the tubes being choked with mucus. In such asthenic patients this salt is preferable to ipecac or squill, which may be indicated in a sthenic bronchial inflammation.

In doses of from 5 to 8 grains, in an aromatic water or bitter infusion, it stimulates the secretion of gastric juice, and may be administered in *atonic dyspepsia, flatulence*, and *colic* due to the latter. In such conditions the aromatic spirit of ammonia or the spirit of Mindererus may be substituted for the carbonate.

Dr. Hope has stated that in those forms of *asthma* associated with *cardiac disorders* great

benefit is derived from this salt in doses of from 10 to 15 grains, six or eight times a day.

The principal use of this salt is as a *stimulant expectorant* in *chronic bronchitis* and in *pneumonia*. Dr. H. C. Wood considers it the best preparation for use in *typhoid pneumonia*. It should be given in doses of from 5 to 10 grains *pro re nata*.

Dr. George Harley, having observed that ammonium carbonate administered in large doses to pigs caused leanness and great muscular hardness, was led to administer the salt in cases of *fatty liver*, in doses of from 5 to 10 grains, thrice a day. This, with a regulated diet of lean animal food, daily exercise, and sulphate of sodium before breakfast, will often cause a rapid diminution in the size of the liver.

Dr. Basham has used it in *diabetes mellitus*, in an effervescing draught, as follows:

℞ Ammon. carb.,
Ammon. phosphat.,
Sodii bicarb.......... āā gr. x;
Tinct. zingib........... gtt. x;
Aq.................... ℥ j.
M.

This is to be taken with a tablespoonful of fresh lemon juice, twice daily. It is said to relieve thirst, diminish the quantity of urine, and decrease the proportion of sugar excreted.

It has been used in *chorea* and *hysteria* with satisfactory results, and Dr. Anstie maintained that if it was administered before an expected attack of *epilepsy* the paroxysm would be averted.

It has had popularity in the treatment of *scarlatina*, in doses of from 2 to 6 grains, in cinnamon water or milk, every one or two hours, but it is not apparent what specific action it can exercise on that disease.

Several physicians have recommended its use in the treatment of *rubeola*, *urticaria*, *roseola*, and *erythema*, but, unless these diseases are accompanied by deficient urea excretion that is corrected by the ammonium salt, the advantage of its use is questionable.

Dr. Beale has found the salt very useful in *cystinuria*.

Experiments made by Dr. Gottbrecht have shown that ammonium carbonate retards putrefaction according to the concentration of the solution employed; a 1-per-cent. solution retarded it until the third day, and a 10-per-cent. solution until about the sixtieth day. A 5-per-cent. solution added to infected gelatin stopped, and a 2½-per-cent. solution hindered, the liquefaction of the gelatin.

Ammonium carbonate is used in the preparation of aromatic spirit of ammonia (see AMMONIA) and of liquor ammonii acetatis (see AMMONIUM ACETATE).

Ammonium carbonicum pyro-oleosum (Ger. Ph.), *sal volatile cornu cervi*, is a compound of 32 parts of ammonium carbonate with 1 part of ethereal animal oil. It is a light-yellow powder that turns brown on exposure to light. It combines in its effects the antispasmodic action of the animal oil and the stimulating action of ammonium. It may be used in *hysterical conditions*. The dose is from 3 to 8 drops. The preparation must be kept from the light in well-stopped bottles.

Liquor ammonii carbonici pyro-oleosi (Ger. Ph.), *spiritus cornu cervi*, is prepared by dissolving 1 part of ammonium carbonicum pyro-oleosum in 5 parts of distilled water and filtering. The dose is from 15 to 40 drops.

Liquor ammonii carbonici (Ger. Ph.) is a filtered solution of 1 part of ammonium carbonate in 5 parts of distilled water.

S. T. ARMSTRONG.

AMMONIUM CHLORIDE, *ammonii chloridum* (U. S. Ph., Br. Ph.), *ammonium chloratum* (Ger. Ph.), sal ammoniac, NH_4Cl, is obtained from the ammoniacal water of gas works. It occurs in tough, translucent, fibrous, inodorous masses, salty in taste, soluble in water and in rectified spirit, volatile without fusion or decomposition. In pharmacy it is used for generating ammonia gas in preparing aqua ammoniæ.

In frequent small doses ammonium chloride causes discomfort and heat in the stomach, diaphoresis, diuresis, and increased secretion of mucus from the gastro-intestinal tract. In large doses, in animals, it produces pain, excitement, collapse, convulsions, and death. It has no effect upon the bile secretion of dogs. In man, as much as two ounces have been taken with no other ill effects than colicky pains and some diarrhœa. Ordinarily, in man, it produces a notable increase in all the solids of the urine, except the uric acid, which is slightly diminished, while the urea is decidedly increased.

Dr. H. C. Wood does not consider that in ordinary doses this salt has any decided influence upon the circulation. Analyses and clinical experience have shown that the continued administration of the salt does impoverish the blood of its solid constituents. The salt acts especially on the mucous membranes. It is chiefly eliminated in the urine, unchanged.

It is most useful in the treatment of acute and chronic *bronchitis*, but is administered in the former condition only after active inflammatory action has been modified. In doses of from 5 to 20 grains it increases the mucous secretion and facilitates expectoration. It has been administered in *intermittent fever*, but there is no positive evidence that it is of the slightest value in the treatment of that disease. It has been a favourite remedy for *gastric* and *intestinal catarrhs*, especially in children, given in doses of from 2 to 10 grains, with extract of licorice. It is a widely employed remedy in *hepatic inflammations*, Dr. Charles Murchison considering that it holds a pre-eminent place. It has proved to be of great value in relieving *hepatic congestion*, as well as in treating *functional hepatic derangement* associated with *lithæmia*. Its diaphoretic and diuretic actions are influential in relieving the portal circulation and allaying pain. Dr. Harley does not consider that it is an antiphlogistic in congestion, as it seems to be a stimulant to both the circulatory and nervous systems, and he agrees with Dr. William Stewart, who first called attention to its use in this condition, that a dry,

hot skin contra-indicates its administration. In the early stage of *hepatic abscess* large doses of ammonium chloride stimulate the absorbents of the liver, and thus tend to avert suppurative degeneration of the liver tissue. For these hepatic affections it may be prescribed in conjunction with either alkalies or mineral acids, and should be given in doses of from 20 to 30 grains, three or four times a day.

A number of observers have recommended its employment in cases of *amyloid liver* in doses of from 60 to 100 grains; but a rigid diet should be enforced at the same time.

In *facial, intercostal*, and *ovarian neuralgias*, in doses of 30 grains from three to four times a day, it has proved of service, but if the pain is not diminished after four doses the use of it should be discontinued and some other treatment instituted. The indications for its use are empirical rather than scientific. It has been recommended for *headache, amenorrhœa, dropsy, hæmorrhages, senile gangrene, whooping-cough*, and *myalgia*, but it is inferior to many other remedies for these conditions.

Inhalations of ammonium-chloride vapour are very useful in *coryza* and *inflammations of the pharynx, larynx*, and *bronchi*. There are a number of inhalers made for the purpose, all of them based on the fundamental principle of mixing the fumes of hydrochloric acid and ammonia water.

Ammonium-chloride troches, *trochischi ammonii chloridi* (U. S. Ph.), are prepared by rubbing together until thoroughly mixed, finely powdered ammonium chloride, 10 grammes (about 150 grains); extract of glycyrrhiza, 25 grammes (about 375 grains); tragacanth, 2 grammes (about 30 grains); sugar, 50 grammes (about 750 grains); and adding enough syrup of Tolu to make a mass to be divided into 100 troches. These troches are used in *pharyngitis, laryngitis*, and *subacute bronchitis*.

Compressed tablets consisting of 5 grains each are much used for catarrhal affections.

S. T. Armstrong.

AMMONIUM CITRATE, $(NH_4)_3C_6H_5O_7$, is obtained by dissolving citric acid in ammonia water, or in water containing ammonium carbonate. In Germany it has been administered in *diseases of the bladder* in doses of from 15 to 45 grains several times a day.

A strong solution of citrate of ammonium, *liquor ammonii citratis fortior* (Br. Ph.), is made by neutralizing 12 oz. of citric acid with 11 fl. oz. (or a sufficiency) of strong solution of ammonia, and adding enough distilled water to make a pint of product. This solution, diluted with four times its bulk of distilled water, constitutes *liquor ammonii citratis* (Br. Ph.). The dose of the stronger solution is from 30 to 90 drops, and that of the weaker from 2 to 6 fl. drachms. The solutions are clear, colourless, and saline in taste. Their action is similar to that of the solution of ammonium acetate.—S. T. Armstrong.

AMMONIUM EMBELATE, *ammonium embeticum*, $C_8H_{13}COONH_4$, occurs as large, needle-shaped crystals of a foxy-red hue. It is precipitated from an alcoholic solution of embelic acid mixed with an excess of strong ammonia water. This salt, which is tasteless, is said to be an effective *tæniafuge* in doses of from 3 to 6 grains, acting where the ordinary tæniacides have failed. It is given in honey, and the dose is preceded and followed by one of castor oil.—S. T. Armstrong.

AMMONIUM FLUORIDE, *ammonii fluoridum*, NH_4F, is prepared by saturating a solution of hydrofluoric acid with ammonia and allowing the mixture to evaporate over quicklime. It crystallizes in colorless hexagonal prisms that dissolve readily in water. It must be kept in gutta-percha or wax-lined bottles. Dr. J. Lucas has prepared a *liquor ammonii fluoridi*, of the strength of 4 grains to 1 oz. of water. This solution has been used to diminish the size of *hypertrophied spleens*, in doses increasing from 5 to 20 drops, in water, after each meal. It has been recommended as an *inhalation in phthisis* in a 2-to-1,000 solution.—S. T. Armstrong.

AMMONIUM FORMATE, *ammonii formas, ammonium formicicum* NH_4CHO_2, is obtained by neutralizing formic acid with ammonia and evaporating the solution until crystallization occurs. It has a pungent taste. It is eliminated, unchanged, in the urine. It has been administered for *reflex paralysis* and for *muscular paresis* due to disuse, in patients in whom there is no active inflammation or irritation of the nervous centres. Its value is questionable. The dose is 5 grains, once or twice a day.—S. T. Armstrong.

AMMONIUM HYDROSULPHIDE, NH_4HS, is formed, in solution, by saturating a caustic solution of ammonia with sulphuretted hydrogen, or, anhydrous, by mixing equal volumes of dry ammonia gas and dry sulphuretted hydrogen. It is a colourless, transparent, volatile salt. There is a German preparation, solution of ammonium sulphydrate, *liquor ammonii hydrosulfurati*, seu *hydrothionici*, that is made by passing a current of sulphuretted-hydrogen gas through a mixture of 30 parts of flowers of sulphur and 180 parts of caustic ammonia solution. It has been used for *catarrhal* and *rheumatic diseases* and for *diabetes*. The dose is from 6 to 15 drops, in water or milk. In doses of from 5 to 6 drops it has been used for *dysuria*.—S. T. Armstrong.

AMMONIUM NITRATE, *ammonii nitras* (U. S. Ph., Br. Ph.), *ammonium nitricum*, NH_4NO_3, is prepared by neutralizing nitric acid with ammonium hydrate or carbonate. It is odourless and deliquescent, and has a sharp bitter taste and a neutral reaction. It is used in the preparation of nitrous-oxide gas; heated to 320° F., it is resolved into this gas and water.

S. T. Armstrong.

AMMONIUM PHOSPHATE.—See under Phosphorus.

AMMONIUM PICRATE.—See Ammonium Carbazotate.

AMMONIUM SALICYLATE.—See under Salicylic Acid.

AMMONIUM SUCCINATE, *ammonii succinas, ammonii succinicum*, $C_4H_4(NH_4)_2O_4$,

is prepared by supersaturating succinic acid with ammonia. It has been used in the treatment of *delirium tremens*, in doses of from 5 to 10 grains, three times a day.

Solution of ammonium succinate (*liquor ammonii succinici, ammoniucum succinicum solutum, liquor cornu cervi succinatus, spiritus cornu cervi succinatus*) is a German preparation made by dissolving 1 part of succinic acid in 8 parts of warm water, and neutralizing the solution with a sufficient quantity of pyro-oleous ammonium carbonate. After standing for twenty-four hours the solution is filtered. It has a brownish colour. It has been recommended in the treatment of *convulsive* and *hysterical disorders*, and in *asthmatic* and *rheumatic conditions*. The dose is from 10 to 20 drops.

With it is prepared an *ethereal solution of ammonium succinate* (*liquor ammonii succinici æthereus, liquor antispasticus*), made by mixing equal parts of the solution of ammonium succinate and *spiritus æthereus* (Ger. Ph.). It is sold under the name of Eller's drops (*liquor antarthriticus Elleri*), and is given for the *convulsive disorders of children*, in doses of 20 drops. From the first-mentioned solution pyro-oleous ammonium succinate (*ammonium succinicum pyro-oleosum*) may be obtained. It is not now used medicinally.

S. T. Armstrong.

AMMONIUM SULPHATE, *ammonii sulphas, ammonium sulfuricum*, $(NH_4)_2SO_4$, is prepared by collecting the distillate from a mixture of ammoniacal-gas liquor and lime in sulphuric acid. It forms anhydrous, soluble, rhombic crystals. It has been used as a *stimulant* in doses of from 15 to 30 grains, but it is inferior to other ammonium salts.

S. T. Armstrong.

AMMONIUM SULPHICHTHYOLATE.—See Ichthyol.

AMMONIUM SULPHYDRATE.—See Ammonium Hydrosulphide.

AMMONIUM TETRETHYLATE, NEt_4OH, is obtained by decomposing ammonium iodide with silver nitrate or its sulphate with baryta. It occurs in slender crystals that are alkaline, bitter, and deliquescent. Mr. T. A. Edison, in experimenting with uric-acid solvents, found that this salt was most efficacious in dissolving that acid or a deposit of sodium urate removed from a joint. Dr. F. Peterson found that 10 drops of a 3-per-cent. solution, injected into an animal's ear, or 15 drops of such a solution, given *per os*, produced no bad results. The writer once undertook an investigation of its therapeutic effects. There was no marked increase of urea excretion following its administration by the mouth in patients suffering with *acute articular rheumatism*. There did not seem to be any specific influence exercised on the course of the disease. It was given in doses of from 10 to 20 drops of a 10-per-cent. solution. In one patient, to whom it was administered hypodermically, there followed at a late period a necrobiosis of the subcutaneous tissue wherever an injection had been made. A sterilized syringe was used, and abscess following hypodermic injections of usual hospital solutions was unknown. No opportunity offered to use it in *gouty deposits*, where, if it is not decomposed in the stomach, it may exercise some curative influence.

S. T. Armstrong.

AMMONIUM URATE, *ammonii urus*, $NH_4C_5H_3N_4O_3$, is formed by digesting uric acid in ammonia solution or by adding ammonium chloride to a solution of urates. It is a white, amorphous salt that dissolves with difficulty. It has been applied in an ointment, in the strength of 20 grains to 1 oz., in *eczema* and other skin diseases. Its therapeutic value is slight, if it has any.—S. T. Armstrong.

AMPLOSIA.—This name has been given to the expressed juice of grapes bottled without having been allowed to ferment. Its use has been recommended as a substitute for the "grape cure." The fermentation is checked by the addition of benzoic acid, but apparently not wholly prevented, for the liquid has been found to contain an infinitesimal amount of alcohol.

AMYGDALA, AMYGDALIN, AMYGDALUS.—See under Almonds.

AMYLÆTHER NITROSUS. — See Amyl nitrite.

AMYL ALCOHOL, $C_5H_{11}OH$, a prominent constituent of fusel oil, especially that obtained from potato spirit, was formerly official on account of its being used in the manufacture of valerianic acid, amyl nitrite, and some other products. It is still employed in medico-legal investigations to extract alkaloids, especially morphine, from watery liquids. It is an active poison, producing muscular rigidity followed by complete relaxation and coma.

AMYLAMINE CHLORIDE, or hydrochloride, $NH_2.C_5H_{11}.HCl$, has been found to reduce the pulse and temperature when given in daily amounts of from 7 to 15 grains. Its use in practice is not to be recommended.

AMYL CHLORIDE.—Chloramyl, pentyl chloride, $C_5H_{11}Cl$, a colourless liquid, of agreeable odour, prepared by the action of hydrochloric acid on alcohol heated in a retort to 230° F. It is an *anæsthetic*, but is slow in its action and in the subsidence of the anæsthesia.

AMYLENE, C_5H_{10}, a derivative of fermentation amyl alcohol, is a mobile liquid of a garlicky odour. It was formerly used as an *anæsthetic*, but was found to be more dangerous than the anæsthetics in common use.

AMYLENE HYDRATE, $(CH_3)_2.C_2H_5.C.OH$, tertiary amyl alcohol, the *amylenum hydratum* of the Ger. Ph., is a colourless, volatile liquid of a camphoraceous and peppermint-like odour. It has been used as an *anæsthetic*, and is considered a comparatively safe one, but is employed principally as a pure *hypnotic*, ranging in potency between chloral hydrate and paraldehyde. It has the advantage over chloral of not increasing nitrogenous waste in cases of its repeated administration for a con-

siderable period of time. It dissolves in 8 parts of water and in all proportions in alcohol. It should be kept in well-stopped bottles and away from the light. The dose is from 15 to 60 grains, and not more than 120 grains should be given in twenty-four hours. It should be taken well diluted with water or wine.

AMYL HYDRIDE.—Pentane, C_5H_{12}, belonging to the paraffin series, a colourless liquid, of a slight but disagreeable odour, said to be of the least density of all known liquids. It is a potent *anæsthetic*, said to act without causing irritation or dyspnœa. Until further observation has established its manageability, its use is not to be recommended.

AMYL IODIDE.—A colourless, pungent liquid, $C_5H_{11}I$, turning brown on exposure to light, prepared by the action of amyl alcohol on iodine in the presence of phosphorus. It was found by Richardson to have *anæsthetic* properties.

AMYL NITRITE, or amylonitrous ether, the *amyl nitris* of the U. S. and Br. Ph's, the *amylium nitrosum* of the Ger. and Austr. Ph's, $C_5H_{11}.O.NO$, is prepared by the action of 1 part of strong nitric acid on 2 parts of rectified fusel oil. Although it was discovered as early as 1844, it was not brought to the notice of the profession until 1865, when Dr. (now Sir) B. W. Richardson, of London, called attention to it. It is an oily, yellowish, inflammable, and very volatile liquid, with a fruity odour very much resembling that of ripe pears. It is rapidly decomposed by coming in contact with water, and nitrous acid is set free; but when it is taken by the stomach it is probably not destroyed before absorption takes place, although Dr. D. J. Leech (Croonian Lectures, *Brit. Med. Jour.*, June 24, 1893) says: "From the comparatively slight effects produced by the nitrite of amyl when taken into the stomach, I am inclined to think but little is absorbed." It is rapidly absorbed in an undecomposed state when inhaled, and its effects when administered by the lungs are prompt and decided.

The most pronounced symptoms caused by inhaling several drops of amyl nitrite are a sudden and intense fulness of the head, which, if the dose is large, amounts to severe pain, especially in the frontal region, flushing of the face, increased frequency and depth of respiration, and exceedingly rapid and irritable action of the heart, without, apparently, much increase in the strength of the cardiac systole. If the dose is sufficiently large to produce the lethal effects of the medicament the face becomes extremely pale, the pupils dilate, great muscular relaxation results, the pulse is weak, rapid, and scarcely perceptible, and respiration is irregular, slow, and shallow. Cases of convulsions, or muscular twitching of the face, very infrequently observed after inhalations of large doses of amyl nitrite, are probably due to asphyxia rather than to the direct influence of the drug on the brain. When lethal doses of amyl nitrite are taken the arterial blood assumes an appearance similar to that of the venous, and before death the blood is chocolate-brown in colour.

The Circulation. — The condition of the heart, pulse, and capillaries indicates the profound influence of nitrite of amyl on the circulation. When this drug is administered, especially by inhalation, in five- or ten-drop doses, the heart's action is suddenly increased several beats a minute. One of the most important questions in relation to the use of amyl nitrite in certain cardiac disorders and depressed conditions is, whether this agent, either directly or indirectly, is a cardiac stimulant, or whether it simply acts as an indirect cardiac accelerator by reason of its depressing influence on the cardiac inhibitory nerves. Professor Reichert, of the University of Pennsylvania (*N. Y. Med. Jour.*, July, 1881), as a result of his experiments with the drug on animals, expresses the view that in small doses it acts primarily as a stimulant to the heart. Most observers, however, hold the opinion that there is no positive evidence to prove that amyl nitrite is a cardiac stimulant. While this agent is not a direct cardiac stimulant, yet by its influence in depressing the inhibitory nerves of the heart it enables this organ to do more work in a given time, and in this manner it may be said to be an indirect cardiac stimulant. With this, as with all other agents which increase the heart's action by depressing one portion of the nervous system, the stimulant effect is transient, and, if large doses are employed, or the use of the medicament is continued for a considerable length of time, it becomes a cardiac depressant. In a few cases irregular action of the heart has been observed after inhalation of nitrite of amyl. The pulse is greatly increased in frequency, and the arterial pressure is lessened almost from the first. As the strength of the cardiac systole undergoes but little change when medicinal doses are administered, it is evident that the lessened arterial pressure is not cardiac in nature. The dilatation of the capillaries which occurs from amyl nitrite is the cause of the decreased arterial pressure. This view is abundantly substantiated by numerous observers and physiological experimenters. Some have attributed the capillary dilatation to the influence of the drug on the central nervous system, but the majority of those who have conducted scientific experiments on lower animals to determine this point are convinced that the capillary dilatation is mainly peripheric and due to paralysis of the muscular coat of the arterioles. Undoubtedly Dr. H. C. Wood is correct in stating: "It is, however, very probable, from the general sedative effect of the drug upon the motor centres, that it acts also upon the vaso-motor centres; and when the local flushings caused by small doses of the poison are borne in mind, this probability is greatly enhanced."

The Nervous System.—Amyl nitrite acts on the nerve centres and nerves as a depressant, affecting principally motor conduction and reflex activity, especially in the spinal cord. The functions of the muscles and motor nerves are depressed, but to a lesser degree than those of the cord. The effects of the drug on the spinal cord have been determined principally by experiments on lower animals. Other symptoms

than spinal are so prominent in man after inhaling the nitrite of amyl that it is almost impossible to determine satisfactorily the effects on the functions of the cord. It is probable that cerebral function is depressed by this agent, but to a lesser extent than the spinal. Nearly all writers are agreed that nitrite of amyl has no direct analgetic effect, and the pain, especially cardiac, neuralgic, and cephalic, which is sometimes promptly relieved by inhaling a few drops of it, is influenced by the direct effects of the drug on the arterioles.

A considerable part of the ultimate depressing effects of the drug under consideration is due to its influence on the blood. These consist mainly of lessened power of oxidation of the hæmoglobin of the blood-corpuscles and impaired vitality and vitalizing influence of the blood. It is important to bear in mind that the arterioles of the lungs dilate from the effects of nitrite of amyl, as it enables us to appreciate the prompt relief afforded by its inhalation in certain cases of angina pectoris and in cases of cardiac dyspnœa. Under such circumstances the sudden dilatation of the pulmonary capillaries relieves the distended cavities of the heart.

The Urine.—Several observers have detected sugar in the urine after giving large doses of amyl nitrite, but it does not seem to produce this result in man when given in medicinal doses. The drug has the effect of temporarily increasing the flow of urine.

The Temperature.—There may be a temporary slight rise of the heat of the mouth and surface of the body after administering nitrite of amyl, but the rectal temperature is said to be diminished from the first. The ultimate effects of the drug in decided doses are to lessen heat production and lower the temperature of the entire body. These results take place in the febrile as well as in the normal condition, and are probably due to dilatation of the cutaneous capillaries, thus exposing the blood to the cooling effects of the atmosphere, with impaired hæmic respiration and lessened metabolic processes.

Dose and Administration.—The average dose of amyl nitrite is from 3 to 5 minims. Much larger doses have been given without untoward results. A dessertspoonful has been swallowed and the patient has recovered, although emetics were employed. Leech (Croonian Lectures, *Brit. Med. Jour.*, July, 1893) mentions a patient suffering from phthisis who inhaled 7 drachms of the drug and succumbed to its influence. Two drachms have been given hypodermically to a patient with cholera in the course of an hour and thirty-six minutes without serious symptoms (H. C. Wood's *Therapeutics*, etc., sixth edition, p. 389). The best method of administration seems to be by inhalation. The drug acts more promptly when given in this manner than when taken by the mouth. When the medicine is administered by an attendant a few drops may be placed on the handkerchief and held near the nose until the face begins to flush or the patient experiences a full sensation in the head. When the patient is allowed to carry the drug and inhale it at will, it is safer to use the pearls, little hollow balls made of thin glass, containing 2 or more drops of amyl nitrite. These balls can readily be crushed between the folds of the handkerchief. If it is desirable to administer it by the mouth, Wood recommends dropping 2 or 3 minims on a lump of sugar and causing it to be taken instantly. As water changes it so rapidly, it is probable that little of the amyl nitrite is absorbed unchanged when it is given in an aqueous menstruum.

Therapeutics.—From a knowledge of the physiological effects of nitrite of amyl it would seem to be indicated in various cardiac, pulmonary, and nervous disorders attended by *angeiospasm* and *increased blood pressure. Angina pectoris* is the most conspicuous affection of the heart for which the drug has been used. Two of the most obtrusive symptoms of angina pectoris are cardiac distress, with various radiating neuralgic pains, and increased blood-pressure. There is a difference of opinion as to whether the increased blood-pressure is the cause of the cardiac distress. Undoubtedly the disease has numerous causes, but the paroxysms of pain are usually attended with increased blood-pressure. It is this latter condition which the inhalation of nitrite of amyl often relieves so promptly, and with it the pain and distress which are so intolerable to the unhappy sufferer. That the drug does not act directly as an analgetic in these cases is evident from the fact that large doses of morphine fail to relieve the pain in some patients whose pain is almost instantly allayed by inhaling a few drops of nitrite of amyl. In some cases of angina pectoris the drug under discussion affords little or no relief, but we are not in a position to determine without trial in what class of cases it may be administered with benefit and in which it is better to refrain from giving the medicament. In the early stage of the disease, no matter what the pathological lesion may be, amyl nitrite is likely to afford partial or entire relief. The shorter the paroxysms the greater the probability that they will yield to the inhalations. In a few instances when 3 or 5 drops have failed, 8 or 10 have been attended with decided benefit. As a rule, if small doses give no relief, larger ones will probably fail. Leech's summary of the use of the nitrite in angina pectoris (*Brit. Med. Jour.*, July 15, 1893, p. 109) may be quoted with advantage: "Of late isobutyl nitrite has been employed occasionally as a substitute for amyl nitrite. Cash finds isobutyl and secondary propyl nitrites somewhat more active in reducing tension than the amyl compound. It has appeared to me, too, that isobutyl nitrite more certainly relieves anginal pain than does official amyl nitrite.

"The inhalation of amyl nitrite sometimes fails to relieve the pain of angina pectoris; this failure may arise from several causes:

"(1) The paroxysms may be due to neuralgia of local origin, or the pain may be reflected or hysterical, and circulatory changes may take but little part in its production. In such conditions nitrite inhalations can do no harm, yet they may fail to relieve pain.

"(2) In some cases the nitrite does not remove pain because of the short duration of its action. It does not break the spell of the vessel contraction. There may be relief, but it is not complete, and when in a minute or two the effect of the drug passes off the wave of contraction returns and with it the pain.

"(3) Some are curiously insusceptible to the influence of amyl nitrite. In such people full inhalations may succeed when slight ones fail, though this is not very common. If a certain measure of success is not obtained with ordinary inhalation, it is not often that a more copious use of amyl nitrite completely removes anginal pain.

"(4) Lastly, in very advanced cases, where the attacks of pain continue long, amyl nitrite may entirely fail to relieve the pain, though in an earlier stage it proved useful for this purpose."

In many cases of *cardiac dyspnœa* inhalations of amyl nitrite afford prompt, although usually only temporary, relief of the patient's most distressing symptom. The question will naturally arise, Will not an agent which causes so great an increase in the heart's action be attended with danger in fatty heart, or in cases of long-standing dilatation, attended with degeneration of the muscular fibres? All are agreed that large doses of nitrite of amyl might prove dangerous and should be avoided in such cases. Many have employed the drug in small doses for the relief of cardiac distress in cases of fatty and dilated heart, and have afforded their patients speedy respite from suffering without observing any untoward results. In such cases the safe rule would seem to be to use the medicament in the smallest possible dose that should be found to relieve the distressing symptoms, and if 3 or 5 minims inhaled were not attended with any benefit, it should not be pushed further. The agent under discussion has been of service in relieving pain in *aortic insufficiency* with excessive hypertrophy and severe frontal headache (Wood). Strümpell has not been able to obtain much help from it in cardiac dyspnœa due to valvular lesion and dropsy. As amyl nitrite seems to be a very feeble cardiac stimulant, if at all a direct one, we should not expect much aid from its inhalation in *syncope* and *cardiac failure*, such as may result from the use of anæsthetics, from shock, etc., yet numerous cases of cardiac failure during anæsthesia, especially from chloroform, have been reported, in which imminent death is believed to have been averted by the timely inhalation of a few drops of this agent. Dr. Edward Rice (*Lancet*, Sept. 19, 1891) reports such a case. It may be that the sudden dilatation of the pulmonary capillaries in such cases relieves the heart, but further than this we are not in a position to give a satisfactory reason for its beneficial effects in such cases.

Amyl nitrite has been used by a number of physicians for the relief of the paroxysms of *dyspnœa due to asthma* and *bronchitis*, but, as might be expected, its influence is of too short a duration to afford more than temporary amelioration. In cases of *nervous asthma* in which the paroxysms come on at a certain time during the night, a few drops of amyl nitrite inhaled at the beginning of the paroxysm may cut it short. As a rule, the other nitrites, especially the nitrite of sodium, nitrite of ethyl, and nitroglycerin, have a more decided influence in the relief of the dyspnœa of asthma, as they are more permanent in their action.

The inhalation of amyl nitrite affords prompt relief from *uræmic dyspnœa* in some cases, but its effects are so transient that it is at best only palliative, and in the majority of cases of this kind its use leads to disappointment. Bals and Broglio (*Bull. méd.*, May 30, 1888) recommend the *tertiary nitrite of amyl*, as its action is more marked and more lasting; it does not produce heat, tension, and throbbing of the head; it can be inhaled without inconvenience or danger in relatively large doses (80 to 100 drops daily), and it acts as a *hypnotic*. (*Ann. of the Univ. Med. Sci.*, 1889, vol. v, 110.)

In *epilepsy*, amyl nitrite, if inhaled during the aura, may avert an impending seizure, and it has been employed with good effect in the *status epilepticus*, in which convulsions follow one another in rapid succession. The effect of the drug is too transient to be of any service in breaking up the habit. *Puerperal convulsions* at times seem to yield to this agent, but its tendency to relax the muscular contraction of the womb, and thus to favour uterine hæmorrhage, has deterred obstetricians from its use. *Hysterical paroxysms* have apparently been cut short by repeated inhalations of nitrite of amyl, and a like result has followed its administration in *catalepsy* and *hystero-epilepsy*. It seems to be worthy of a more extended use in hysteria than the majority of physicians heretofore have accorded to it. While the course of *tetanus* is too long for us to expect a decided curative effect from inhalations of nitrite of amyl, yet its influence in depressing the excitability of the spinal cord and in relieving paroxysms of dyspnœa makes it an agent of great value to meet the emergencies in this troublesome disease. By its timely administration severe paroxysms of muscular spasm can be prevented while the patient is being fed, and at times death may be averted by relaxing the tonically contracted respiratory muscles. The favourable results following its administration in tetanus certainly justify its use in this disease. *Migraine* attended with angeiospasm, and *headache due to anæmia of the brain* are favourably affected by the inhalation of amyl nitrite. This agent has been used in *cerebral anæmia*, but it is evident that it can have only a temporary effect. Strümpell recommends amyl nitrite in *trigeminal neuralgia*, but does not seem to have much confidence in its use in this trouble. Dr. Alfred L. Loomis advises the employment of amyl nitrite in the *vertigo of seasickness*, and recommends its inhalation on the first appearance of nausea (*Practical Medicine*, p. 1079). Numerous observers have given the drug under consideration in various *reflex vaso-motor disturbances*, and especially those connected with the climacteric and menstrual periods. It is said to have afforded relief in these cases from

depressed mental conditions, cold hands and feet, peculiar flushings, hysterical manifestations, and, at times, pain. From the powerful influence of amyl nitrite in promptly dilating the capillaries we should expect good effects from its use in the stages of asphyxia and syncope in *Raynaud's disease.* I am not aware that it has been used in this affection.

Dr. Alexander P. Rudsky (*Ann. of the Univ. Med. Sci.*, 1891, vol. v, 102) describes an interesting case of *cocaine poisoning* in which nitrite of amyl proved to be a successful antidote. Several similar cases have since been reported. Professor H. C. Wood advises inhalations of amyl nitrite to lessen the spinal reflexes in *strychnine poisoning*, and gives results of experiments in which the administration of twice the ordinary fatal dose of strychnine was followed by recovery when this drug was employed as the sole antidote.

J. T. ESKRIDGE.

AMYLONITROUS ETHER.—See AMYL NITRITE.

AMYLUM.—See STARCH.

AMYL VALERIANATE, $C_5H_{11}.O.C_5H_9O + C_{10}H_{20}O_2$, is an ethereal liquid of an agreeable apple-like odour. It has been recommended in *hepatic* and *nephritic colic*, also as a *calmative* and *antispasmodic*, and for the relief of *migraine* and *neuralgia.* It has recently been employed by Dr. Blanc (*Brit. Med. Jour.; Med. Record*, Nov. 17, 1894, p. 623) not only for the relief of attacks of hepatic colic, but also to prevent their recurrence, which it is thought to do by virtue of a solvent action on the concretions of cholesterin. Dr. Blanc has found it useful also in *muscular rheumatism*, in *spasmodic dysmenorrhœa*, and in *hysterical paroxysms.* The dose is 1½ grain. in a capsule, and five or six doses may be taken in the course of twenty-four hours.

ANACARDIUM OCCIDENTALE.—See CASHEW NUT.

ANACYCLUS.—See PYRETHRUM.

ANÆSTHETICS are agents that for the time being annul or deaden sensitiveness to pain. When they affect the entire organism profoundly they also cause total loss of consciousness, complete relaxation of the voluntary muscles, and other phenomena to be mentioned further on. The condition thus produced is known as general anæsthesia; local anæsthesia is insensibility of a part, due to the topical action of an anæsthetic agent. In a certain sense all anæsthetics are thought to be local in their action; anæsthesia is held to be produced, not by the effect of the anæsthetic agent upon particular organs of the central nervous system, but by its actual presence in all the tissues, whither it is carried by the blood.

There are many drugs that, if given in doses large enough to prove fatal, lead to a state of profound unconsciousness and insensibility, but only as one of the manifestations of their deadly action; we reckon as anæsthetics, however, only those agents that give rise to anæsthesia regularly and without notable danger. The number of these is now considerable, although it was not until the nineteenth century was well advanced that such an agent as an efficient and manageable anæsthetic was known. It is true that the ancients are credited with having made use of various drugs that may have mitigated the pain of a surgical operation in some faint degree, but (except by employing exceedingly dangerous doses of narcotics or possibly, as has been surmised, inducing asphyxia with carbonic-acid gas set free from the "stone of Memphis") we may be sure that they never succeeded in effecting any close approach to what a modern surgeon would look upon as satisfactory anæsthesia. No better did the moderns succeed until the fifth decade of the present century, within which brief period of time the three great anæsthetics—nitrous oxide, sulphuric ether, and chloroform—were made known to the world. It is said, indeed, that so long ago as in 1799 Sir Humphry Davy became aware that something more than exhilaration could be produced by the inhalation of nitrous oxide—a degree of insensibility to pain—but he did not carry his observations so far as to enable him to see that "laughing-gas" could be made available as an anæsthetic; that discovery was reserved for Horace Wells, a dentist, of Hartford, Connecticut, who in 1844 began to use the gas to prevent pain in the extraction of teeth. He had been led to try it by having observed that some of the persons to whom it was administered at public exhibitions given by G. Q. Colton, an itinerant lecturer, became insensible to blows, etc., that would ordinarily give rise to pain. Wells continued to use the gas in his dental practice, and made a praiseworthy effort to demonstrate to the medical profession its availability as a surgical anæsthetic in an operating theatre in Boston. Unfortunately, there was some fault in its preparation or administration on that occasion, and it failed to produce the desired effect; consequently its use as an anæsthetic was soon forgotten, but only to be revived on a grand scale twenty years later.

In 1846 another dentist (afterward a physician), William T. G. Morton, of Boston, succeeded in showing, in the same operating theatre, that of the Massachusetts General Hospital, that inhalation of the vapour of sulphuric ether was capable of producing entire insensibility to the pain of a surgical operation. For several years before, Morton had occasionally taken part in those curious gatherings of frolicsome young students of medicine, pharmacy, and dentistry that took place here and there at various times, at which ether vapour was inhaled for the purposes of exhilaration and merriment. It was reflection on these experiences, together with vague hints that he had been able to pick up from chemists—notably Dr. Charles T. Jackson, of Boston—that led Morton to try ether as an anæsthetic.

Opinions are divided as to who should be credited with the honour of having first discovered the anæsthetic property of ether, for a number of physicians had experimented with it, and, in particular, it is well established that Dr. Crawford W. Long, of Jefferson, Geor-

gia, used ether as an anæsthetic in surgery as early as in 1842. Morton's demonstration, nevertheless, was incontestably the event that proclaimed the practicability of surgical anæsthesia, which immediately became general the world over. In the following year, however, it was made known, chiefly by the efforts of Dr. (afterward Sir) James Y. Simpson, of Edinburgh, that chloroform was an efficient anæsthetic. It was at once recognised that chloroform had the advantages of being speedier in its action and much more agreeable to the patient; consequently it soon came into common use in Europe, almost to the exclusion of other anæsthetics. In most parts of the United States, however, ether has always held its place as the leading anæsthetic, and for the last few years there have been growing indications that European surgeons were coming to realize that supreme advantage of ether—safety. Absolute safety, it is true, there is not in the use of any anæsthetic; so profound a perturbation of the processes of life as the total abolition of all sensation can not be brought about without some little risk. It is our plain duty, therefore, always to employ the anæsthetic that experience has shown to be the least dangerous, unless in an individual instance there is some special reason to choose some other. The question, as between chloroform and ether—and that is practically the whole question—will be treated more fully in the article on ETHER.

All the drugs that act as general anæsthetics are either gases or highly volatile liquids; there are, however, certain agencies, such as hypnotism and rapid breathing, that are processes, not substances. Hypnotic anæsthesia will be considered in the article on HYPNOTISM. A few years ago some experiments made in Philadelphia went to show that brief anæsthesia could be induced by causing the patient to lie on his side, with his eyes bandaged so as to withdraw his attention from the surroundings, and getting him to breathe at the rate of about a hundred times a minute for from two to five minutes. Professor Henry M. Lyman, of Chicago, in his admirable monograph on *Artificial Anæsthesia and Anæsthetics* (New York, 1881), explains the anæsthesia thus induced as perhaps partly or in some instances one of the phenomena of the apnœa that results from surcharging the blood with oxygen, and as partly or in other instances a feature of incipient asphyxia resulting from overdistention of the veins produced by the "puffing" expiration which is one of the elements in the process. It is doubtful if this method of anæsthetization has anything to recommend it save as an expedient in case none other is practicable.

General anæsthesia is almost always induced by causing the patient to inhale the anæsthetic gas or vapour, but it is possible to accomplish the object in some other way, as was shown by the practice of *rectal etherization* that came into vogue a few years ago and was largely resorted to for a brief period, during which it caused death in a number of instances, so that it soon came to be abandoned. In this method of anæsthetization the vapour of ether, hastened in its evolution by the application of heat to the vessel holding the liquid, was conveyed into the rectum. The process was for a time thought to be particularly advantageous in cases in which there were special reasons for sparing the patient the irritation of the air-passages that attends the inhalation of the vapour of ether. In the fatal cases intense hyperæmia of the rectum and of the adjoining portion of the colon was found post mortem.

When the vapour of ether or chloroform is inhaled, if the inhalation is conducted properly, anæsthesia comes on gradually, but is sometimes preceded by various unpleasant phenomena, such as a choking sensation and coughing, due to the pungency of the vapour; the delirium of incipient anæsthesia, sometimes inducing the patient to attempt acts of violence or otherwise misbehave, but quite involuntarily; transitory convulsive movements; and vomiting. Finally the individual has the appearance of a person in deep sleep, and, if the anæsthetization is carried to a profound degree, resembles one in a state of coma, snoring heavily and with the muscles utterly limp. Ordinarily, full surgical anæsthesia need not be carried to this extreme.

Among the early phenomena of anæsthetization with ether is a condition termed *primary anæsthesia*. It is an anæsthesia that lasts for a few seconds only, but long enough to serve the purpose when only a puncture or a single rapid incision is to be made, as in opening an abscess. The way to take advantage of this primary anæsthesia was thus described by the late Dr. Gaspar Griswold (*New York Med. Jour.*, xxxiii, 1881, p. 572): "The operator stands with his knife ready; the patient is told to hold one hand raised above his head, and is given some ether to inhale. As the critical moment is reached, the patient becomes temporarily unconscious, and allows his hand to fall. The incision is then made at once. The return to consciousness is complete in a few minutes, and is attended with no nausea or other discomfort."

Vomiting is a troublesome and often dangerous occurrence that may take place at almost any period of the process of anæsthetization—troublesome in that it hinders further procedures for the time being; dangerous from the tendency of the vomited matter to drop into the larynx and cause either immediate suffocation or remote bronchitis. Often has it been necessary to perform tracheotomy for the removal of a piece of undigested meat that had thus found its way into the air-passages. Vomiting may usually be prevented by instructing the patient to abstain from taking food for several hours before the time set for the operation, but he should not be told to do so for so many hours as to weaken him by lack of needed nourishment; this is a matter for judgment and discrimination. As a patient emerges from the anæsthetic state, especially if he has been long subjected to it, he is at first dazed, and is apt to suffer with headache and nausea. The complete return to the condition he was in before the anæsthetization often requires

several hours for its accomplishment. During all this time he should be watched carefully.

As a rule, women and children are more readily anæsthetized than men; they require less of the anæsthetic. Occasionally an individual well-nigh proof against anæsthesia is encountered, but, if the ether or chloroform is pure and its administration well managed, success is always the result. There are few persons whom it is not safe to anæsthetize, but a patient's condition should, when practicable, be carefully examined before a decision is made as to the time and method of anæsthetization. If the person is subject to fainting attacks or the victim of serious pulmonary or cardiac disease or of any grade of Bright's disease, general anæsthetics should be avoided if possible, or used with the greatest caution. In an article published in the *Deutsche medicinische Wochenschrift* (summarized in the *Therapeutic Gazette* for December, 1894), Dr. Baxer shows that it is dangerous to anæsthetize diabetics with chloroform, even if the diabetes is not pronounced. They recover from the anæsthesia, but fatal coma is prone to occur within a few days, preceded by indifference, stupor, and confusion. Fortunately, local anæsthesia is now so readily produced under a wide range of conditions that there are few instances in which a general anæsthetic is indispensable, although for most major operations it is to be preferred in the absence of any special contra-indication.

The danger attaching to the use of approved anæsthetics is very small; small as it is, however, we should strive to reduce it to the minimum, and the work of anæsthetization should never, if it is possible to avoid it, be intrusted to a tyro. The anæsthetizer should give his attention exclusively to his own work, never allowing himself to get so interested in what the operator is doing as to lose sight for a moment of the patient's behaviour under the action of the anæsthetic. Such a spectacle as that of an etherizer craning over toward the field of operation, and even resting his elbows on the patient's chest in boorish forgetfulness, thus materially hampering respiration, is revolting, and yet the writer has witnessed it in the operating theatre of a hospital of great renown. Whoever could be guilty of such conduct is not only grossly incompetent to administer an anæsthetic, but really unfit to practise medicine. The anæsthetizer should endeavour to induce anæsthesia gradually, with as little discomfort to the patient as possible. The particular procedures in the induction of anæsthesia will be given in the articles on the individual anæsthetics.

It is quite necessary to know when the patient is sufficiently anæsthetized to admit of the operation being begun, for, if an incision is made while he is still capable of feeling the pain of it, the unexpected impression made on the nervous system may, says Dr. Lyman, be severe enough to cause sudden death. A ready test is that of raising the patient's arm and letting it fall to the table; if it falls limp and lifeless, the anæsthesia is sufficiently profound. The test of touching the ocular conjunctiva with the tip of the finger is fallacious, for to some persons such an impression is not ordinarily painful; moreover, it involves taking an unwarranted liberty with a helpless person. When full anæsthesia has been produced, the anæsthetizer should thereafter administer just so much of the anæsthetic as may be necessary to maintain anæsthesia of the degree required, and no more, and he should continue the administration by adding small quantities of the anæsthetic to the cone or napkin frequently, rather than by allowing the patient almost to emerge from the anæsthesia and then flooding him with more of the vapour. He should take care that at all times the patient has plenty of air to breathe, laden with no more of the anæsthetic vapour than is necessary; to no degree should asphyxiation play a part in the induction of anæsthesia. From the very beginning of the process the pulse and the breathing should be watched closely, also the condition of the skin; copious perspiration accompanied by heavy, stertorous breathing calls for a temporary suspension of the inhalation. *A fortiori*, at the least sign of real danger, whether from failure of the respiration or weakening of the heart's action, the inhalation should be stopped, and measures at once resorted to for warding off a catastrophe. In cases of threatened failure of the breathing, it usually suffices to sprinkle a little cold water on the chest and to endeavour to evoke spontaneous respiratory movements by alternate compression of the lower part of the chest and pressure upon the epigastrium. If these measures do not succeed promptly, the patient should be suspended with the head down, and then systematic measures to set up artificial respiration resorted to, including insufflation through a tracheal tube. The expedient of seizing the tongue with a tenaculum and drawing it forward is of some value, and should be adopted especially when the body is suspended. This procedure is resorted to simply to establish and maintain patency of the rima glottidis; it must not be confounded with Laborde's method, to be described in the next paragraph.

In the year 1894 Dr. J. V. Laborde, director of physiological experiments to the Paris Faculty of Medicine, published a work entitled *Le Traitement physiologique de la mort: les tractions rhythmées de la langue.* The somewhat startling first term of this title—*the physiological treatment of death*—was really meant to apply to the management of suspended animation, the resuscitation of the asphyxiated, by means of *rhythmical tractions of the tongue.* M. Laborde tells us that he had frequently succeeded in restoring animation to asphyxiated animals in his laboratory, and that at length it happened to him to be called upon in the case of a person who had been asphyxiated by submersion, and for whose restoration all known measures other than that of rhythmical tractions of the tongue had proved ineffectual. With his method he succeeded in bringing back the manifestations of life, and in his book he recounts a considerable number of cases in which it has been employed successfully. These were cases (one) of a foreign body

in the larynx, of asphyxia neonatorum, or of asphyxia from submersion, from an electrical shock, from tetanus, or from the inhalation of sewer air or the vapour of chloroform. Up to the time at which the book was published not a case of failure had occurred, and the procedure was taken up enthusiastically, with the result that in the course of a few months it had been resorted to successfully in a great number of instances. It consists in seizing the tongue with a forceps, with a hook, or with the fingers guarded with a handkerchief, and pulling upon it regularly and with a rate of frequency corresponding roughly to the normal rate of respiration—from eighteen to twenty-five times a minute. M. Laborde explains the reviving effect of these rhythmical tractions by supposing that the throat reflexes are among the last to be destroyed in cases of asphyxia, and that the irritation of pulling upon the tongue is conveyed by the superior laryngeal, the glosso-pharyngeal, and the lingual nerves to the respiratory centre in the medulla oblongata, whence a motor impulse in response is sent by the phrenic nerve and by the nerves going to the thoracic and facial respiratory muscles. The procedure, he thinks, is preponderatingly, if not solely, a stimulus of respiration, with little if any primary effect on the heart, for he has found it unavailing after division of the phrenic nerves. Whether or not we can accept this explanation without reserve, it is to be conceded that M. Laborde has added materially to the stock of resources we can draw upon in the endeavour to resuscitate asphyxiated persons, and rhythmical tractions of the tongue should be resorted to, it may be said, in all cases of asphyxia from anæsthetization, *provided other measures are not neglected*. It will not do to depend upon this one procedure to the neglect of others; the patient should be placed in such an attitude (on the side) that liquids may flow from the mouth freely, the mouth itself should be freed at once with the finger or a sponge probang of the vomited matter or thick, frothy mucus that may be obstructing the entrance to the air-passages, and the well-known means of artificial respiration employed conjointly with the tongue-pulling. According to Hare (*Am. Pract. and News*, Nov. 3, 1894, p. 357), artificial respiration should be preceded by extension of the neck and tilting of the head forward, which can readily be carried out with the fingers behind the head and the thumbs resting against the angles of the lower jaw. This procedure causes the epiglottis to rise.

If a faradaic apparatus is at hand, the efforts at artificial respiration may be assisted by rhythmical faradization of the right phrenic nerve, one electrode being placed just at the outer side of the carotid artery above the clavicle and the other on the right side of the chest, in the sixth intercostal space, and the current, which should not be a strong one, allowed to flow only during those artificial respiratory movements that are designed to excite inspiration. Any form of electrization of the pneumogastric nerve must be avoided; otherwise, if the heart is still acting, its action will be stopped at once. Random applications of electricity not only involve the waste of precious time, but may actually prove detrimental. Whatever measures are resorted to must be continued patiently and unremittingly until the patient either breathes regularly or is dead beyond peradventure.

For his own protection, a physician should avoid the administration of a general anæsthetic without the presence of a third person to guard against credence being given to any charge of misconduct to which the patient may subsequently subject him. Such charges —generally of taking liberties with the person, if not of actual rape—have often been made, and they are not necessarily malicious, but may be founded on the remembrance of a vivid hallucination occurring as one of the phenomena of incomplete anæsthesia. In such cases the accuser's manifest sincerity gives her a great advantage in court.

Now and then the question comes up in court as to the possibility of inducing anæsthesia in a sleeping person without waking him. Such anæsthetization with chloroform has been shown to be possible, but its success in the hands of a person unaccustomed to the process is exceedingly improbable, and surely would never take place in the dramatic way that newspaper-writers are fond of depicting, by the thrusting of a sponge drenched with chloroform close before the victim's nose, with the effect of producing anæsthesia *instantly*. When criminal anæsthetization is charged, evidence of the most minute character should be brought forward before the charge can be held to be proved.

Ordinarily, anæsthetics are used to prevent the pain of a surgical operation, but it is not alone the avoidance of suffering that they accomplish—they lessen the shock of a severe operation, guard against involuntary movements on the part of the patient that might seriously interfere with the surgeon's procedures, and relieve the operator from the horrible consciousness that he is inflicting pain, and so leave him free to do whatever seems best for the patient, without regard to the amount of cutting, tearing, stretching, sawing, crushing, etc., that may have to be done. Quite apart from the domain of operative surgery, moreover, general anæsthetics have a wide range of usefulness. Especially are they of unspeakable service in midwifery. To render the pains of childbirth bearable is so easy and so free from danger that, in the absence of a particular contraindication, any parturient woman who calls for an anæsthetic should be allowed to have it. The inhalation of a very little chloroform vapour as each pain comes on will answer the purpose, although at hardly any time will the patient's consciousness be fully lost. When, however, it becomes necessary to perform one of the major obstetrical operations, the use of chloroform should be abandoned, and that of ether substituted for it. General anæsthesia is often resorted to for the purpose of securing relaxation of the voluntary muscles, in order to facilitate the reduction of a dislocated bone, also to enable the

physician to explore the abdominal and pelvic contents more thoroughly than he could otherwise without inflicting unbearable suffering and evoking embarrassing spasmodic muscular action. It is useful also as a means of detecting the feigning or the involuntary simulation of disease. In certain convulsive diseases, notably puerperal convulsions, anæsthetics are serviceable.

"*Mixed Anæsthesia.*"—This term is applied to the conjoint use of a narcotic and an anæsthetic. It has been found that the hypodermic injection of a very small dose of morphine about half an hour before the inhalation of chloroform is to be begun shortens the stage of excitement and renders it practicable to maintain the required degree of anæsthesia with less chloroform than would otherwise be needed. The administration of a small dose of atropine before giving chloroform by inhalation conduces to the patient's safety, for atropine is a stimulant of the respiratory centre. In the case of ether the preliminary use of morphine has not generally been found advantageous, but rather the reverse, for it prolongs the stage of excitement, increases the frequency of vomiting, and retards the recovery of consciousness. However, the use of a hypodermic injection of morphine as ether anæsthesia passes off, to lull pain that may be expected to come on, is commonly practised, and is to be recommended. The administration of chloral before that of ether has been found little less unpleasant than that of morphine.

Local anæsthesia, in the therapeutical sense, is induced anæsthesia limited to a particular part. In many cases it is to be preferred to general anæsthesia, because it is generally less unpleasant and less dangerous to the patient. Often, however, it is prejudicial to the vitality of the tissues involved in the operation, or tends to shrink or exsanguinate them and then set up a secondary hyperæmia of them, whereby hæmorrhage is favoured; moreover, in the case of almost any grave surgical procedure it is to the patient's interest that he should not be conscious of what is being done. On the whole, it will generally be found wise to resort to general anæsthesia in performing major operations, unless there is some special reason for not doing so. Local anæsthesia is brought about by freezing the part by causing a fine spray of some very volatile liquid, such as rhigolene or ether, to play upon it, or by the instillation or injection of an anæsthetic drug, notably cocaine. (See Cocaine, Ether, and Rhigolene.)

ANAGALLIS.—The flowering herb of *Anagallis arvensis*, pimpernel, *herba anagallidis*, was formerly used in infusion as a remedy for rabies and various other diseases. It is said to contain a digestive ferment.

ANAGYRINE, $C_{14}H_{18}N_2O_2$, is an alkaloid obtained from the seeds of *Anagyris fœtida*, a papilionaceous plant of the group *Podalyrieæ*. It is an active poison, paralyzing the function of respiration.

ANALEPTICS are tonic and restorative remedies.

ANALGENE, or *orthoethoxyanamonobenzoylamidoquinoline*, $NHOOC_6H_5H$, is a synthetical derivative of quinoline occurring as a white, crystalline powder insoluble in water, but readily soluble in hot alcohol and dissolving sparingly in cold alcohol. As first prepared, it contained acetyl, but the substitution of benzoyl for that radicle has been found to heighten its therapeutical action decidedly. It is used as a remedy for *neuralgia*, *rheumatism*, and *spasmodic asthma*. The dose is from 7 to 15 grains, which may be repeated in two hours if necessary. It is said that analgene sometimes imparts a cherry-red colour to the urine, but that this is of no pathological significance.

ANALGESICS.—See Analgetics.

ANALGESINE.—See Antipyrine.

ANALGETICS are agents that give relief from pain, and include the anodynes and most of the antineuralgics. All anodynes are antineuralgics, but such antineuralgics as arsenic, iron, strychnine, quinine, and the nutrient agents, foremost among which is cod-liver oil, are not anodynes. Pain is the conscious recognition of an irritation in some portion of the nervous system, and is due to disease or perverted conditions which affect nerve tissue directly or indirectly. Anodynes are simply pain-relievers, and are given to lessen the normal or heightened sensibility of a part; while antineuralgics are made to include these, they also comprise remedies which are supposed to aid in removing dyscrasic blood states which are not infrequently the cause of the pain. It is probable that all the analgetics might be included under the antineuralgics, but, as custom favours it and it seems convenient, a short space will be devoted to anodynes.

Anodynes.—The most powerful and certain are opium and some of its derivatives, morphine and codeine. Were it not for the unpleasant effects in many persons following the use of opium, and the danger of establishing the drug habit, we should rarely have occasion to resort to other remedies for the direct relief of pain. Since, however, the direct effects of opium on some are more distressing than the pain which it has been given to relieve, and the danger of creating a craving for opium is always great in persons who are, or become, tolerant of its effects, it often devolves upon us to resort to other agents, either alone or in combination with it. Anodynes should be employed with judgment and caution. If possible, the patient should never know what he is taking, and it should be impossible to have the prescription for an anodyne renewed without the knowledge and consent of the physician. A combination of two or more of these agents prevents the patient from becoming accustomed to the sole influence of either. When anodynes have to be continued for a considerable length of time, one drug should be substituted for another every few days. In treating the hysterical and the neurotic the physician should always be on his guard lest the drug habit be established.

Opium and its Derivatives.—In all cases of sudden, violent, and acute pain, such as attends an attack of cholera morbus, a severe surgical injury, or a paroxysm of suffering so common in certain lesions of the nerves and central nervous system, nothing takes the place of one of the salts of morphine, preferably the sulphate, administered hypodermically in doses varying from eight milligrammes ($\frac{1}{8}$ of a grain) to two centigrammes ($\frac{1}{3}$ of a grain), or even more, according to the severity of the pain. Hysterical paroxysms should not be relieved by opium in any form, as a rule. It is better to let the patient endure some suffering until relief is obtained by other, slower and safer, measures, lest the habit of resorting to opium on every occasion confirm the patient in invalidism, and establish the drug habit. The pain caused by acute inflammation of the serous membranes, especially of the abdomen, chest, and joints, is often relievable only by opium in some form. For the relief of *angina pectoris*, a hypodermic injection of morphine is often resorted to, and not infrequently with good effect, but it is just here that acute pain may at times be promptly relieved by an agent that has no direct analgetic properties. Amyl nitrite, early in the disease, if the patient is allowed to inhale from 4 to 8 drops, affords relief almost instantaneously, even when morphine has failed. Pain as a result of *enteritis*, *excessive intestinal peristalsis*, or *tenesmus*, yields promptly to opium, and in *tenesmus* camphor is an excellent adjuvant. Comparatively small doses of opium in combination with other agents not infrequently act better in relieving continuous pain than large doses when given alone. This is seen especially in cases of *inflammation of the sciatic nerve*, where $1\frac{1}{2}$ centigramme ($\frac{1}{4}$ of a grain) of morphine with $\frac{3}{8}$ of a milligramme ($\frac{1}{98}$ of a grain) of atropine will often give relief for twenty-four hours or longer; but if morphine is injected alone, several injections are required to produce the same effect. Opium acts well in combination with cannabis indica or belladonna in relieving *pain of uterine* or *ovarian origin*. While we should not administer opium if one of the other anodynes will give the necessary relief, when we are compelled to give it, the smallest possible dose should be used, except for the relief of severe pain, especially of traumatic origin, when the quantity should be sufficient to afford prompt relief. When opium is administered by the mouth, old opium pills will often be followed by less disagreeable effects than morphine or the other preparations of opium. In the early stages of *meningitis* the hypodermic use of morphine promptly relieves pain and allays restlessness, and apparently has no bad effects upon the morbid process.

Codeine.—There are two preparations of codeine, the sulphate and the phosphate. The latter, on account of its ready solubility in water (about 1 to 4 parts), is preferred for hypodermic administration; 0·061 gramme (1 grain) of codeine is equivalent to about 0·0103 gramme ($\frac{1}{6}$ of a grain) of morphine. Codeine is less likely than morphine to disorder the stomach, constipate the bowels, and produce disagreeable itching of the skin, but it is not entirely free from these unpleasant effects, and it is a much less reliable agent for the relief of pain. In the chronic inflammatory and degenerative diseases of the nervous system, in which anodynes have to be employed over long periods, codeine, especially if combined with cannabis indica and phenacetine, may obviate the use of morphine.

Cannabis indica.—When this is given alone it has, as a rule, very feeble anodyne properties, except in *pain of ovarian* or *uterine origin* and in many cases of *nervous* and *reflex headaches*. To relieve pain with cannabis indica, it must be given in sufficiently large doses to produce the physiological effects of the drug. Obstacles to the use of this agent are the difficulties heretofore experienced in obtaining reliable preparations of uniform strength and the unpleasant, though harmless, sensations experienced from its use. The most reliable of the solid extracts that I have used is the one made by Hering, of England. The dose of this varies from 0·008 gramme ($\frac{1}{8}$ of a grain) to 0·016 gramme ($\frac{1}{4}$ of a grain), and even the smaller dose will be found to produce decided physiological effects in some persons. The extracts made by most American manufacturers may be given in doses varying from 0·016 gramme ($\frac{1}{4}$ of a grain) to 0·066 gramme (1 grain), or even more. Next to the extract made by Hering, the "normal liquid" made by Parke, Davis, & Co. seems to be the most certain in its strength. This may be given in doses varying from 0·185 gramme (3 minims) to 0·616 gramme (10 minims). Cannabis indica given in capsules with acetanilide or phenacetine, citrate of caffeine, and monobrominated camphor aids in relieving pains from most of the chronic nervous disorders for which morphine has been commonly used.

Anæsthetics.—Ether or chloroform promptly relieves pain and relaxes muscular spasm. They are indicated when immediate relief from pain and an antispasmodic are demanded. The suffering caused by renal and hepatic colic is almost immediately relieved by these agents.

Belladonna.—This remedy for the relief of severe pain, unless the suffering is due to spasm of involuntary muscles, when used alone, is almost valueless. Its best effects for the relief of pain are obtained when it is employed in connection with morphine. A small quantity of atropine added to morphine greatly aids in relieving the pain of *lead*, *hepatic*, and *renal colic* and *spasmodic dysmenorrhœa*. When it is remembered that belladonna relieves pain largely by relaxing muscular spasm, especially of the involuntary muscles, the indications for its use as an anodyne will be appreciated. This agent has been employed for the relief of *pain caused by spasm of the voluntary muscles*, but to have much effect under such circumstances it must be injected directly into the affected muscles. Belladonna seems to prolong the anodyne effect of the morphine, and a prolonged relief from pain may be obtained by injecting morphine and belladonna into *inflamed muscles* and into or around *inflamed nerves*. For the relief of pain from

spasm of the muscular fibres of the intestines, belladonna is administered by the mouth, and for this purpose the tincture, from 0·308 to 0·924 gramme (5 to 15 minims), the alcoholic extract, 0·008 to 0·032 gramme ($\frac{1}{8}$ to $\frac{1}{2}$ a grain), or the fluid extract of the root, 0·0616 to 0·123 gramme (1 to 2 minims), may be used. For hypodermic administration, sulphate of atropine is the most eligible preparation in a dose of from 0·0006 to 0·001 gramme ($\frac{1}{100}$ to $\frac{1}{64}$ of a grain).

Antipyrine, in doses varying from 0·66 to 1·33 gramme (10 to 20 grains); *phenaceline*, in doses of from 0·20 to 1·33 gramme (3 to 5 grains): *exalgine*, in doses of from 0·133 to 0·266 gramme (2 to 4 grains); *acetanilide*, in doses of from 0·20 to 0·33 gramme (3 to 5 grains); *asaprol*, in doses of from 0·20 to 0·33 gramme (3 to 5 grains); *salol*, in doses of from 0·33 to 0·66 gramme (5 to 10 grains), and some other agents of this group, given every two, three, or four hours, according to the urgency of the case, are capable of relieving pain. All except antipyrine are best administered in capsules or in pill form. On account of their antiseptic properties, these remedies are efficient in relieving *headache* caused by the products of fermentation of the gastro-intestinal canal.

Antineuralgics.—In referring to neuralgia in this connection the so-called idiopathic form is meant. Neuralgia proper is due to perverted nutrition and reflex or direct irritation. The perverted nutrition may be caused by altered blood states or temporary or permanent increased or decreased blood supply to a part. Mechanical or chemical irritants may give rise to direct or reflex pains or to both. In selecting a line of treatment for any form of neuralgia the cause must be searched for and removed if possible.

The Choice of Antineuralgics for Neuralgia due to Altered Blood States.—The condition of the blood may be due to anæmia or to toxic agents, such as alcohol, lead, malarial poison, and various toxines. The toxic irritants must be removed by appropriate agents, and the blood must be improved by hygienic measures, nourishment, and remedies that have a tonic action. *Physical rest*, sometimes *absolute rest* in bed, is often of the greatest advantage, but this depends upon the character of the anæmia. Blood-corpuscles are able to absorb and carry oxygen in proportion to their richness in hæmoglobin, and if this is reduced to a greater extent than the corpuscles, physical rest becomes of the first importance. Under such circumstances rest should be secured even at the loss of abundance of fresh air, which is of less importance. It is well known that muscular exertion uses up oxygen; and if the corpuscles are poor in hæmoglobin, the tissues suffer in their nutrition, and the organic functions, such as digestion, respiration, and circulation, are imperfectly performed. In most forms of anæmia except the pernicious variety the hæmoglobin is deficient, and rest is frequently of marked benefit in the treatment. On the other hand, the blood-corpuscles sometimes contain from 25 to 50 per cent. more hæmoglobin than normal in pernicious anæmia, so that in neuralgia from this form of anæmia a slight amount of exercise is beneficial. Exercise in moderation should only be denied to neuralgics whose nervous disturbance is due to well-marked non-pernicious anæmia. Fresh air is an aid to tissue metamorphosis, and should be sought for neuralgics, but not at the expense of needed rest. An abundance of easily digested, nutritious, and appetizing food should be insisted upon, and the best is animal food. *Cod-liver oil* is an excellent agent in the treatment of those forms of neuralgia which are due to impaired nutrition. *Hydrotherapy*, *massage*, and sometimes *electricity* are excellent aids in improving nutrition and in overcoming a neuralgic diathesis.

The antineuralgic remedies that have a tonic action are arsenic, iron, quinine, strychnine or nux vomica, the zinc salts, especially the phosphide and valerianate, and free phosphorus. *Arsenic* and *iron* are the most useful of the remedies just mentioned in neuralgia due to anæmia. It is well in most instances to give iron and arsenic at the same time. The form in which iron is administered matters but little if it does not disarrange the digestive organs. *Lactate* and *pyrophosphate of iron* are two excellent preparations which may be administered in capsules in 0·324-gramme (5 grain-) doses thrice daily to persons who are unable to tolerate the tincture of the chloride or the other astringent forms of the metal. For the prolonged administration of arsenic *Fowler's solution*, in 0·123-gramme (2-minim) doses thrice daily after meals, is one of the most convenient methods of giving it. *Quinine* in non-malarial cases is an excellent antineuralgic in anæmic persons, and need not be given in more than 0·130-gramme (2-grain) doses thrice daily. *Strychnine* or *nux vomica* forms part of most prescriptions for the relief of patients suffering from neuralgia caused by impaired nutrition. Either is an efficient agent. *Phosphide of zinc* is an excellent tonic, and may be given in capsules in doses varying from 0·004 to 0·208 gramme ($\frac{1}{16}$ to $\frac{1}{3}$ of a grain) thrice daily after meals. *Valerianate of zinc* does not seem to be a very reliable tonic in neuralgia, but has been more effectual as a sedative in cases attended with considerable emotional disturbance. Free *phosphorus*, dose 0·0006 gramme ($\frac{1}{100}$ of a grain), has been extensively used in neuralgia, but it is only occasionally that it seems to do much good.

Special Agents in the Treatment of Neuralgia due to Altered Blood States other than Simple Anæmia.—Neuralgia caused by chronic malarial disease is best treated by a few antiperiodic doses of quinine, then by quinine in tonic doses in combination with iron and arsenic. Of late I have had success in treating *neuralgic pains of chronic malarial origin* by methylene blue in doses varying from 0·016 to 0·048 gramme ($\frac{1}{4}$ to $\frac{1}{3}$ of a grain) in a capsule with powdered nutmeg three or four times daily. In small doses it rarely disorders the stomach if given with nutmeg. It discolours the urine and sometimes causes vesical and urethral irritation if the doses are very large

and continued for some time. In *neuralgia caused by syphilis*, potassium iodide and mercury are specifics. In *neuralgia due to lead*, potassium iodide and bromide apparently act better than the iodide alone in getting rid of the lead deposited in the tissues. *Neuralgia from chronic alcoholism* is always associated with anæmia. Besides withdrawing alcohol, those agents must be employed that have been recommended in anæmia.

Choice of Remedies in Neuralgia due to Increased or Lessened Blood Supply to the Part affected.—Increased vascularity may be temporary or constant. The cause may be reflex, local, or general, giving rise to vaso-motor disturbances which result in dilatation of the arterioles. If possible, the cause should be removed. The *bromides* have a good influence in *congestive neuralgias*, especially affecting the head (probably the cerebral dura), but *aconite* and its active principle, *aconitine*, are more efficient and reliable. Duquesnel's preparation of aconitine may be given in doses varying from 0·0003 to 0·0006 gramme ($\frac{1}{200}$ to $\frac{1}{100}$ of a grain) every two hours with decided benefit in this form of *neuralgia affecting the fifth cranial nerve*. *Gelsemium* is often an efficient agent in *trigeminal* and *ovarian neuralgias*. The fluid extract may be given in doses varying from 0·135 to 0·308 gramme (3 to 5 minims) every two hours till the physiological effect of the medicine is experienced or the pain is relieved. The tincture is of about one third the strength of the fluid extract. As the strength of different official preparations of gelsemium varies greatly, it is safer to begin with the smaller dose and gradually increase until the desired effect is obtained.

In *neuralgia due to deficient blood in a part*, nerve and cardiac stimulants, such as *sulphuric ether*, *valerian*, *nitroglycerin*, *amyl nitrite*, or small quantities of *alcohol*, are useful. In some cases of neuralgic headache, attended with insufficient blood in the brain, amyl nitrite or nitroglycerin affords prompt relief. Unless pain is relieved by these agents with a few doses, it is not likely that a further trial of them will be beneficial. When the neuralgia is due to certain diatheses, such as rheumatism and gout, appropriate remedies must be given for these conditions. Sometimes neuralgia caused by the presence of an irritant, such as a diseased tooth, remains after the offending body has been removed. Under such circumstances the neuralgic habit must be broken up by sedatives, anodynes, and tonic agents.

Agents for the Immediate Relief of Neuralgic Pain.—Some of the remedies already mentioned afford prompt ease. Among these may be instanced *amyl nitrite* and *nitroglycerin*. *Opium* and its preparations—*cocaine*, *cannabis indica*, *belladonna*, *croton-chloral*, *antipyrine*, *phenacetine*, *acetanilide*, *exalgine*, *asaprol*, *salol*, *methylal*, and *chloride of methyl*—have been used by the mouth, and a number of them hypodermically, for the pain of neuralgia. Opium and its preparations afford almost immediate relief from suffering, but they should never be resorted to in neuralgia if it is possible to do without them. When they are employed, it is safer to use them with other remedies. For hypodermic use morphine and atropine form the best combination. *Hydrochloride of cocaine* injected at the seat of pain, 0·016 gramme ($\frac{1}{4}$ of a grain), often affords great relief. On account of the danger of the cocaine habit, it is not a remedy to be trifled with. *Cannabis indica* in full doses, especially when combined with acetanilide or phenacetine, is a safe remedy. It alone acts excellently in relieving *headache in the neurasthenic*. To break up the *headache habit* in these cases it is often necessary to keep up a gentle physiological effect of the medicine for several days. *Belladonna* is not a reliable anodyne in neuralgia, but at times it acts well when combined with other anodynes. *Butylchloral hydrate* (croton-chloral), in 0·324-gramme (5-grain) doses every half hour, administered in syrup, often gives relief in *trigeminal neuralgia*. If the pain is not greatly lessened by the time four or five doses have been given, it is probable that further trial will be useless. *Antipyrine*, *phenacetine*, and *acetanilide* are useful remedies for the relief of neuralgic pains, but it is not well to rely upon them to the exclusion of other agents with which it is advantageous to give them. The most useful of them are cannabis indica, codeine, and belladonna. Caffeine citrate prevents depression from the steady use of such depressing agents as antipyrine, phenacetine, and acetanilide, and monobrominated camphor seems to increase their power in relieving pain. I must confess that I have been disappointed in the use of *exalgine*. It may have been that the preparations were not pure. I have had no experience in the use of *methylal*, so highly spoken of by some for neuralgia in superficial nerves. It may be administered by the mouth or hypodermically in 0·324- to 1-gramme (5- to 15-grain) doses. Debove has praised *chloride of methyl* as an analgetic in *sciatica*, *lumbago*, *and trigeminal neuralgia*. It is applied in the form of a spray to the skin over the affected nerves. I have employed the method first practised in this country by Dr. Frederick Peterson, of New York, with the effect of promptly relieving pain in the trigeminal nerve. It consists in using a solution of cocaine, morphine, or some other analgetic agent in a properly constructed electrode which is attached to the positive pole of a galvanic battery and applied over the affected nerve. The negative electrode, if the trigeminal nerve is the seat of the pain, is applied at the back of the neck. Five or ten milliampères will be found sufficient for the strength of the current, although Peterson recommends a much greater strength. [See under ELECTRICITY.] Several external applications, such as camphor-chloral (equal parts of each rubbed together), veratrine ointment, heat, cold, mustard paste, and blisters have been used with success in certain forms of neuralgia.—J. T. ESKRIDGE.

ANAPHRODISIACS.—See ANTAPHRODISIACS.

ANATRIPTICS.—Medicinal preparations designed for use by inunction.

ANDA OIL.—An oil (*oleum andæ*) said to be obtained from the fruit of *Johannesia princeps*, a South American tree of the *Euphorbiaceæ*, and to have the medicinal properties of castor oil without its disagreeable odour. The dose is one fourth that of castor oil. An alkaloid, *johannesine*, has been found in the oil.

ANDIRA.—A tropical genus of papilionaceous trees. The wood of *Andira Araroba* contains Goa powder. *Andira anthelminthica* is a Brazilian species the fruit of which is used as an anthelminthic. *Andira bark, cortex andiræ*, is thought to be derived chiefly from *Andira* (*Geoffræa*) *inermis* and *Andira retusa*. It is a violent emeto-cathartic. In doses of from 5 to 20 grains, it is used for the expulsion of *lumbricoid worms*. The dose of a non-official fluid extract used in France is from 15 to 30 grains.

ANDROGRAPHIS PANICULATA, *Justicia paniculata*, is an acanthaceous annual found in India, Ceylon, and Cochin-China. The bark is official in the Ph. of India as *andrographis cortex*. It is a stomachic tonic resembling chiretta, for which it is sometimes substituted. An infusion is made with 5 parts of the bark and 100 of boiling water.

ANDROPOGON.—A genus of grasses, mostly tropical. *Andropogon pachnodes* is official in the Ph. of India, also *Andropogon citratus*. From the leaves of these and other species several varieties of aromatic oil, the *oleum andropogi citrati* of the Ph. of India, are distilled. The oil is used as a carminative and as a stimulating embrocation.

ANEMONE PRATENSIS, ANEMONE PULSATILLA.—See PULSATILLA.

ANEMONIN, $C_{15}H_{12}O_6$, a camphor-like crystallizable substance found in *Anemone pratensis* and in several allied plants, is a violent poison. It has been used in *dysmenorrhœa* in doses of from 0·015 to 0·077 of a grain.

ANETHUM FŒNICULUM.—See DILL.

ANGEIONEUROSINE. — See NITROGLYCERIN.

ANGELICA.—Several species of this genus of umbelliferous plants were formerly recognized in the pharmacopœias, and *Angelica Archangetica* (*angélique officinale*), garden angelica, still figures in the Fr. Cod. The root and the fruit are tonic and provocative of appetite.

ANGINE.—Crude wool-fat.

ANGOSTURA, ANGUSTURA. — See CUSPARIA.

ANHALONIUM LEWINII, a Mexican cactaceous plant, now referred to the genus *Mamillaria*, is the source of "muscale buttons." It contains an alkaloid, *anhalonine*, which has been found to act as a tetanizing poison.

ANHYDROSULPHAMINEBENZOIC ACID.—See SACCHARIN.

ANIDROTICS.—See ANTIHIDROTICS.

ANILINE, $C_6H_5.NH_2+2H_2O$, called also *phenylamine* and *amidobenzene*, was first obtained by the distillation of certain indigoes, but is now one of the coal-tar products. It is a colourless, aromatic liquid, of an acrid, burning taste. soluble in 31 parts of water and in all proportions in alcohol, ether, or oils. It is an alkaloid, forming crystallizable salts with acids. It is an irritant poison, and continued exposure to it leads to muscular weakness, a leaden or bluish discoloration of the skin and nails, various cutaneous eruptions, and mental disorders. It has been used medicinally in daily amounts of from 0·77 of a grain to 2·31 grains, in water acidulated with sulphuric acid, chiefly in *chorea* and *epilepsy*, but its employment as a drug is open to the objection that it is apt to give rise to unpleasant effects, and its remedial efficiency does not seem to be such as to warrant its use. Several of its derivatives, however, have come into extensive use.

Aniline Camphorate, $(C_6H_7N)_2C_{10}H_{16}O_4$, has recently been employed by Tomaselli as an *antispasmodic*. It is a white or reddish crystalline substance obtained by dissolving 50 parts of camphoric acid in 150 parts of absolute alcohol, and adding 56 parts (or enough to make a neutral solution) of aniline. The crystals are obtained by evaporating this solution. They are soluble in water, glycerin, alcohol, or ether. Glycerin dissolves one tenth of its weight of the salt, and a 10-per-cent. glycerin solution will bear dilution with an equal bulk of water without becoming turbid. From 8 to 12 grains of aniline camphorate may be given in the course of twenty-four hours.

ANIMAL EXTRACTS AND JUICES.—The time has not yet arrived to pass final judgment on the value of most of the animal extracts as therapeutic agents. Some, most prominent among which is the *thyreoid extract*, will find a permanent place in therapeutics, while others, probably the non-glandular extracts, may share the fate of so many quasi-therapeutic agents which have flourished one day and been forgotten the next. From time immemorial there has lingered a vague and indefinite belief in the efficacy of animal substances in the cure of disease. Ancient pharmacy was filled with vile and disgusting compounds made from the excreta or bodies of animals, fish, reptiles, or insects.

According to the *Medical Press* (1889), Horace, in one of his odes, pays his respects to the invigorating influence of the animal extracts and beseeches the witch Canidia to reveal to him the secret of the draught which she prepared at night by crushing in a mortar pieces of flesh torn from the most fiery horses of Rome, and the patricians, says the Latin poet, used this mysterious liquid with great confidence. (*Medical Record*, July 20, 1889, p. 70.)

"Dr. Archie Stockwell, in the *Therapeutic Gazette* for January, 1890, wrote an elaborate historical and critical article regarding the *testicular secretion* in therapeutics. According to this author, Paracelsus anticipated Brown-Séquard, for out of the sperma hominis he made his homunculus, and asserted that 'it was good against the imbecility of the instruments of generation.' In the *Hortulus genialis*

of Baricellus, Genoa, 1620, is found a receipt for sexual rejuvenescence the principal ingredient of which is the testicle of the wild boar, and a parallel prescription is offered in a work by Elzen Blaze one hundred and twenty years later. During the seventeenth century reproductive products as obtained from mammals, birds, and fishes still enjoyed an enviable reputation as cerebro-spinal and genital excitants; they were occasionally endowed with specific attributes in diseases of mucous membranes or those due to nervous derangements, such as 'the falling sickness,' chorea, and neurasthenias. They were, however, more generally employed to restore sexual vigour and increase virility, and found a prominent place in the London Pharmacopœia as issued by the Royal College of Physicians in 1676, and also in Salomon's *New London Dispensatory* of 1684. In the eighteenth century most animal remedies were dropped from the Pharmacopœia, and the testicles among them." (*Ibid.*, Feb. 15, 1890, p. 186.)

It is quite evident, from a study of the mode of preparation and administration of the animal substances employed in medicine prior to a recent date, that they were unattended with any beneficial effect beyond the psychical, and that they held a place in the pharmacopœias only on account of the superstition and mysticism which dominated medicine for a number of centuries.

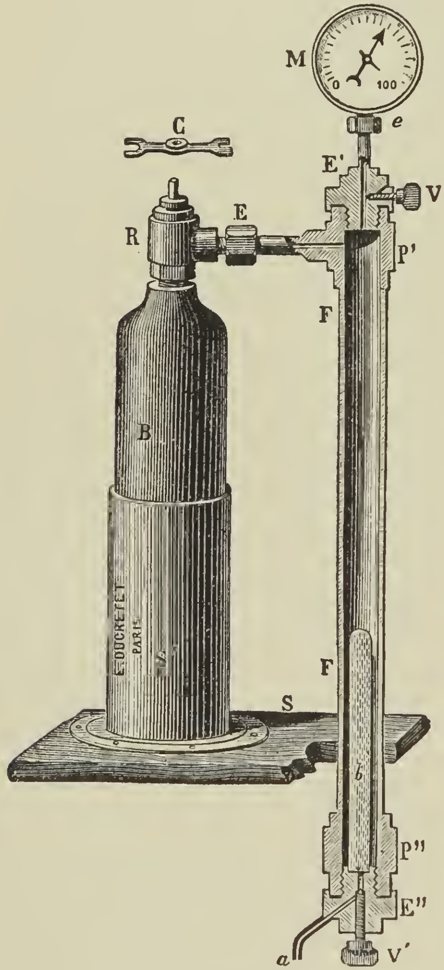
To the eminent investigator Brown-Séquard is due the credit of directing the medical profession to the study of the animal extracts and juices as therapeutic agents. Regardless of the value that we may attach to the importance of his investigations and discoveries in animal therapeutics, we should not hesitate to accord to him scientific enthusiasm, indomitable perseverance, and honesty of purpose, notwithstanding that by reason of advancing years he was inadvertently led to attach an undue importance to his orchitic fluid. Much of the odium and ridicule which have deservedly been heaped upon some of the preposterous allegations for the testicular fluid have been due more to the blind enthusiasm of many of Brown-Séquard's followers than to the direct statements of the eminent physiological investigator himself, although, in candour, we must admit that in his review On a New Therapeutic Method Consisting in the Use of Organic Liquids extracted from the Glands and Other Organs (*British Medical Journal*, June 3 and 10, 1893) he accepted the unwarranted statements of others as proof of the marvellous influence of the orchitic fluid in the cure of certain organic diseases of the spinal cord.

In 1869, at the Paris School of Medicine, Brown-Séquard delivered several lectures the principal object of which was to establish the fact that all glands, with or without excretory ducts, gave to the blood by an internal secretion principles which were of great importance if not necessary. He endeavoured to show this to be the case for the kidneys, the suprarenal capsules, and the sexual glands. In 1875 he reinvestigated this subject at Nahant (near Boston), and professed to have confirmed the correctness of the views which he had advanced in 1869. He says: "I thought that if we could safely introduce the principle of the internal secretion of a gland taken from a living animal into the blood of men suffering from the lack of that secretion, important therapeutic effects would thereby be obtained. In February, 1889, in a paper deposited at the Biological Society, I stated that I had found that means, and it consisted in injecting under the skin the liquid extract we can get easily from glands by pressure, with the addition of a little water. Since then, with the help of my assistant, Professor d'Arsonval, I have pushed matters considerably forward, and I have especially tried to prove that not only glands, but all tissues, have, besides their influence on blood resulting from the interchange of nutrition, an internal secretion." (*British Medical Journal*, June 3, 1893.)

As many of the unpleasant results following hypodermic injections of animal liquids seem to be due to the presence of septic material in the fluid, it is of the first importance that every necessary precaution to procure thoroughly sterilized extracts should be taken. The mode of preparation of all organic extracts given by Brown-Séquard, from a paper by d'Arsonval (*British Medical Journal*, June 3, 1893), is probably the best, and I shall reproduce it here with the illustration which accompanies the description.

"We procure the testicles" (these glands are only mentioned for example, as Brown-Séquard states that the same procedure is followed in the preparation of all the animal extracts for hypodermic administration) "of bulls at the slaughter house. Just after the killing of the animal a ligature is placed as high as possible on the whole mass of the spermatic cord, so as to get at least a certain amount of the blood contained in the veins. When the organs reach the laboratory their coverings are at once removed with scissors sterilized by heat. The organs are then washed in Van Swieten's liquor" (corrosive sublimate 1 part to water 1,000 parts), "and afterward in recently boiled water. That being done, each of the organs is cut in four or five slices, which, with the piece of cord, are placed in a glass vase, in which is thrown, for each kilogramme" (about 2·2 pounds) "of the organs used, 1 litre" (about a quart) "of glycerin marking 30 degrees. The vase is covered, but it is essential during the next twenty-four hours to turn over a good many times the slices and other pieces of organs. At the end of that period an addition of 500 cubic centimetres" (a pint) "of freshly boiled water, containing 25 grammes of pure chloride of sodium, is made. The liquid so obtained is made to pass through a paper filter (we use the syrup gray filter No. 8 of the Laurient series). Before doing this, however, we hardly need to say that the paper filter and the glass funnel in which it is placed must be thoroughly washed with boiling water. The filtered liquid is slightly rose-coloured. To hasten the filtration it is well to raise the temperature of the glycerin solution to 40° C." (104° F.); "the viscosity is thereby suppressed.

"Of the various means we have made use of to obtain a liquid absolutely free from microbes or other dangerous pieces of solid matter, the most important is the one we will now describe. The sterilizing d'Arsonval filter, represented in the annexed figure, is composed of a metallic hollow cylinder, which receives and keeps immovable the thick steel bottle, *B*, filled with liquid carbonic acid; a metallic tube, *F F*, which has borne the weight of 200 atmospheres; a metallic stopper screwed on the lower extremity of this tube, and carrying the filtration bougie, *b*. This bougie is of a



kind of clay in which kaolin is replaced by pure alumina; it is fixed on the metallic stopper by an India-rubber tube, which is made to press most tightly on the bougie and the central metal. A screwing top, *V*, is attached to the metallic stopper, and by it we can at will close or open the apparatus. When it is opened, the liquid which has passed inside of the filter *b* runs out through the tube *a*. The top of the tube, *F F*, is closed by a metallic stopper, *V*, which is surrounded by a manometer graduated up to 100 atmospheres, and carries also a screwing top, which allows the escape of the accumulated carbonic gas when this is needed. An adjoining lateral tube, *E*, serves for communication between the sterilizing filter and the liquid carbonic acid contained in the steel bottle, *B*. A stopper, *R*, with a steel point, put in action by a key, *C*, gives the possibility of establishing or stopping communication between the two tubes *B* and *F F*, so that the pressure against the liquid which is to be filtered may be gradual. The two tubes or two apparatuses form a whole, fixed on a wooden tablet, *s*, which is screwed firmly on a table. To sterilize the glyceric liquid it is first thrown into the tube *F F*; then, after having screwed solidly the superior stopper on which is the manometer, *M*, and having turned to the end of the closing screws, *V* and *V'*, the tap, *B*, of the steel bottle, *B*, is opened. The carbonic acid enters rapidly into the tube *F F*, and presses over the liquid. A pressure of 50 to 60 atmospheres is maintained for about an hour, during which all the microbes that may be present are crushed and killed. The pressure may be increased, notably if the apparatus is submitted to a temperature of 40° C. (104° F.). Neither the albuminoids nor the soluble ferments are in the least altered, as has been ascertained with pancreas and yeast. When the sterilization is considered sufficient (from half to one hour for tissues of a healthy animal), the tap, *V'*, is opened, and the liquid filters rapidly through the bougie, *b*, after having been submitted to two sterilizations, the first one by CO_2 under pressure, the second by the filtration."

There are several methods of preparing some of the animal extracts, but the one adopted by Brown-Séquard is probably the most reliable. It has the disadvantage that the extracts should be used soon after they are made, as they begin to deteriorate within a few days. Extracts whose efficacy is not destroyed or greatly impaired by the digestive fluids may be made dry, and then can be kept for a considerable length of time. The dry thyreoid extract is the principal one on the market to-day. The Columbia Chemical Company, of Washington, D. C., makes liquid preparations of most of the glands, and of many of the other tissues of the body, and states that they may be kept without fear of deterioration for any reasonable length of time. My experience with this company's preparations is not sufficient to enable me to draw just comparisons between them and those made according to the d'Arsonval method at the Pasteur Institute, of New York.

The question is often asked, Is there any therapeutic value in the animal extracts and juices? Some have painted in glowing terms alleged results from their use, which, to say the least, are marvellous, while others, many without giving them a trial, and some without extended experience in their use, have denounced most of them in unmeasured terms. When we come calmly to review the literature of the whole subject we are forced to the conviction that all the animal extracts, when injected

hypodermically, exert some influence on the organism. The fault seems to have been due to two causes: A number have exhibited too great eagerness in reporting experiments and too great enthusiasm in detailing real or supposed results; while others, disregarding all facts, have refused to investigate or be convinced. The unpleasant effects of the testicular juice on epileptics, and the brilliant results obtained from the use of the thyreoid gland, or an extract made from it, in myxœdema and other diseases, to say nothing of serum therapy, etc., should, in view of the fact that ordinary therapeutic measures are so unsatisfactory in dealing with many diseases for the treatment of which great pretensions are made by some for animal extracts, determine us to wait carefully results which competent and reliable observers seem to obtain from the use of various animal substances. We are not asked, or even expected, to accept theories. That every non-glandular organ of the body possesses an active principle which, when administered hypodermically, is capable of exerting a special influence in disease of that tissue or organ from which the liquid is extracted, is too chimerical, it seems to me, to deserve serious consideration. Such substances, when introduced in a concentrated form into the subcutaneous tissues, may act as tonics or stimulants to the nervous system; they may, inherently or by virtue of some leucomaine which may develop, possess some antitoxine influence, and thus result in destroying or neutralizing toxines which may be the direct cause of the disease for which the extracts are being used. There are, no doubt, other ways by which these animal agents may act in neutralizing the effects of disease. If we are to make advance in this line of therapeutics we must first accept facts and patiently wait for satisfactory explanations, which may or may not come.

Before considering the individual animal extracts, it may not be amiss at this time to say a few words in regard to their administration and the precautions necessary to observe when the hypodermic method is employed. It seems to be conceded that the vast majority of the animal extracts of the glands or other tissues from which the extracts are derived, when taken into the stomach, have their active principle destroyed by the digestive ferments. We know that the toxic principles of woorara and serpent's venom are neutralized by the digestive agents. Numerous observers find an exception to this general rule in the thyreoid gland, whose therapeutic powers are nearly as great when it is administered by the mouth as when it is given subcutaneously. According to Dr. C. Macalister, the thymus gland and the medulla of bone do not lose their therapeutic effects when administered by the mouth. Most of the extracts of animal matter, as now made, contain considerable glycerin, and are too irritating for hypodermic use in their pure state.

The syringe which is employed when administering these extracts should be large enough to hold about three or four times as much as is necessary for a dose. After the requisite quantity of the extract has been drawn into the syringe the instrument should be completely filled with freshly boiled water and shaken to allow the fluids to mix thoroughly. Thorough aseptic precautions should be observed in giving the injection. The part into which the needle is to be thrust should be well washed with soap and water, and afterward with a corrosive-sublimate solution. The needle and syringe should be rendered aseptic by immersing them in boiling water just before using them, and it is a good plan to clean them again by the same means immediately after giving the injection. It is probable that the unpleasant local effects following the injection of the animal extracts, such as great pain, inflammation, and sometimes abscess, have been due to septic material in the liquid or to microbes carried into the tissues from the septic skin on the needle of the syringe. Those who have been most careful in obtaining thoroughly sterilized animal extracts and have employed every aseptic precaution in introducing them have had no abscesses to report from this treatment. As many object to the hypodermic injections of the animal extracts on account of the pain that not infrequently follows their use in this manner, the mucous surfaces of the rectum and mouth may be made use of with advantage for those extracts whose active principle is destroyed by the digestive ferments. When the mouth is used, about twice the usual quantity for subcutaneous injection should be dropped on the tongue, and the patient requested not to swallow for half an hour. When the rectum is the method of administration, about twice the dose given by the mouth should be given in an ounce or two of water. There will not be much difficulty in retaining the rectal injection and getting it absorbed if the lower bowel has been previously cleared by an enema and the patient remains in the recumbent posture for half an hour after receiving the extract. Rectal digestion is so feeble that it is probable that the liquid will be absorbed without undergoing much change.

Orchitic or Testicular Liquid.—On June 1, 1889, at the Société de biologie, Brown-Séquard made his first communication on the orchitic liquid. Within a short time he presented several reports to the society on the use of this liquid, a full account of which is found in the *Lancet* of July 20, 1889. As a result of a few injections in his own person the eminent physiologist maintained that his mental and physical vigour, and his power of endurance without the accustomed fatigue, were increased. Before the use of the injections a half hour's work in the standing posture in his laboratory exhausted him. After the second injection he was able to work for two or three hours without any feeling of exhaustion, the dynamometer showed increased power of the muscles, constipation and paresis of the bladder were relieved, and, while before the treatment he had felt unusually feeble for his age (seventy-one years), after the use of the orchitic liquid he experienced a vigour that he had known thirty years before. The sexual passion and appetite were said to be increased. Following Brown-Séquard's early communications on the influ-

ence of the orchitic fluid injected into the subcutaneous tissue, a number of medical men, both in Europe and in America, reported the results of their experience with the liquid in question, and some of them alleged greater effects than the illustrious physiologist had thought possible, while the more conservative had obtained either negative results—barring accidents, such as pain, inflammation, or abscesses at the seat of the injection—or, at most, only temporary stimulation of the nervo-vascular system in persons who were in feeble health. Results were so contradictory in the experience of different observers that the marvellous statements of some served to bring the agent into disfavour. Had it not been for the brilliant experience on the functions of the thyreoid gland by Schiff, von Eiselberg, Bircher, and Victor Horsley, it is probable that to-day the Brown-Séquard treatment would be simply a matter of history.

Locomotor Ataxia.—In 1892 Professor Brown-Séquard and Professor d'Arsonval agreed to furnish all kinds of animal extracts that might be asked for by physicians, on the condition that the histories of the cases, with the results of treatment, should be sent to them. More than twelve hundred physicians availed themselves of this generous offer, and as a result Brown-Séquard and d'Arsonval received reports of over sixteen hundred cases that had been treated by the orchitic liquid. Among these cases there were three hundred and forty-two of locomotor ataxia in which the diagnosis seemed to be reliable. Of this number, three hundred and fourteen were reported improved or cured. Dr. Depoux, who seemed to have been the first to use the orchitic fluid in locomotor ataxia, reported five complete cures, six cases of progressive amelioration, and two failures, out of thirteen cases treated. Dr. Gilbert, a physician of Havre, treated two cases, with a cure in each. Victoroff, of Moscow, treated seven cases, with a result of five either cured or greatly ameliorated. Brown-Séquard states: "The various other kinds of sclerosis of the cord give a proportion of 85 per cent. of cures or ameliorations, while ataxy gives about 90 per cent." (*British Medical Journal*, June 10, 1893). It is due to Brown-Séquard to state that he adds: "We reserve the question of cure of organic diseases. All that we have just stated applies to the cessation of morbid manifestations." One case of locomotor ataxia treated by means of the orchitic fluid by Dr. Depoux, of Paris, and one by Dr. Gilbert, of Havre, certainly showed remarkable improvement, which was maintained when the report was made, nearly a year after the treatment had been discontinued. In none of the cases of locomotor ataxia treated by means of the orchitic fluid have the knee jerks returned, so far as I have been able to learn. Depoux's patient received, from August 6 to 10, 1892, 2 cubic centimetres of the orchitic liquid each day hypodermically; from August 30th to September 10th, 6 cubic centimetres daily. Improvement at this time was quite marked. He was next subjected to treatment on November 15th, and from this date to the 24th he received each day 12 cubic centimetres of the fluid, when he considered himself practically cured. Dr. Gilbert's patient was subjected to two series of injections of the extract of bull's testicles, at a month's interval. Each series consisted of twelve injections, three being given a day.

In the *New York Therapeutic Review*, vol. ii, No. 2, Dr. Paul Gibier reports four cases of locomotor ataxia treated by injections of orchitic fluid and nervous matter. All the patients showed improvement in general health. Besides this, in one case an old perforating ulcer of the sole of the right foot healed in a few days; in the second the bladder regained its power, constipation disappeared, and walking became better; in the third, after fifteen injections, an increasing weakness lessened, standing became possible with the eyes closed, and diplopia disappeared; in the fourth, severe pains were relieved, sensation was very much improved, and walking became much better. Others have reported great improvement in locomotor ataxia from the use of hypodermic injections of the orchitic fluid. Owspenski, of St. Petersburg, reported twenty-nine cured or markedly improved out of thirty-six treated (*Year-Book of Treatment*, 1893, p. 92). My personal experience with the use of the orchitic fluid in the treatment of locomotor ataxia has been limited. I have not been able to obtain any material made according to the d'Arsonval method. I have used the preparation made by the Columbia Chemical Company and a preparation at one time made by Parke, Davis, & Co., but from neither have I seen any permanent results. In two cases of locomotor ataxia, as nearly alike as it was possible to get them, to one patient I gave the liquid preparation said to be made from the testicles of animals, and to the other nothing of special importance was given. Beyond a sense of excitement experienced for a few minutes, and sometimes for an hour or more, by the one to whom the testicular juice was given, I was unable to detect any difference in the daily condition of each patient, and at the end of two months, if I had not known, I should have been unable to say to which the orchitic fluid had been given.

The test to which I have put the liquid in question has not been a satisfactory one, and I should wish to employ the preparation made at the Pasteur Institute in New York before speaking definitely of its effects. It does seem, however, that if the testicles possess any agent of a tonic or antitoxine effect, this might be obtained by rectal feeding with the freshly expressed juice from the glands. Unless some such method of administering the active principle of the glands is found feasible, it is going to be impossible to give patients who live at a considerable distance from large cities the benefit of the treatment, on account both of the expense and of the impossibility of using the material in a fresh state.

Tuberculosis.—The conservative element of the medical profession was unprepared for the virtues alleged by a number of physicians for the orchitic fluid in the treatment of tubercu-

losis. Brown-Séquard, after speaking of the effects of the testicular fluid in locomotor ataxia and cancer, says: "There is no other serious affection of any kind which has not given us a good proportion of cases of considerable amelioration. I will only say that the favourable results obtained in the treatment of pulmonary tuberculosis in the Hôtel-Dieu Hospital, of Paris, by Drs. Dumontpallier and Variot, and at the Charité Hospital by Professor Cornil and Dr. Hénoque, and also at Lille by Professor Lemoine, have been confirmed by more than sixty medical practitioners of Paris or of the French provinces." Dr. D. Uspenski, in a lecture before the Russian Society of Public Hygiene (Epitome of the *British Medical Journal*, Jan. 10, 1891), stated that he had tried this "emulsion" on eighteen patients in all stages of tuberculosis. Two acute cases had been given up. In one, that of a lad of eighteen, in which all other measures had failed, the appetite and general condition were greatly improved after three injections, and after six the patient was able to leave his bed and walk about his room. Under continued treatment, strength and weight increased, temperature gradually fell, night sweats ceased, and the patient could take a long walk. Fifteen injections were given between the beginning of May and June 15th. The treatment was stopped and the patient continued to gain strength and weight through the summer, the increase in weight being from 122½ to 148½ pounds. The lung mischief came to a standstill. In another man, aged twenty-eight, fever and profuse sweating were associated with bacillary phthisis of both apices. After the sixth injection the appetite improved, after the twelfth the patient was able to leave his bed, and after the eighteenth the temperature became normal. There was, however, no increase in weight and the lung condition was not improved. In chronic cases the injections acted more rapidly; in twelve such, marked general improvement, with reduction of fever and lessening of night sweats, occurred after from two to four injections. Nine, or at most twelve, injections usually suffice, he says. The bacilli do not disappear entirely, but diminish in proportion to the extent to which the diseased process recedes. The author considers that Brown-Séquard's fluid has a markedly beneficial effect on the general health in all cases of phthisis. On the other hand, Dr. M. K. Zienier (*ibid.*, 1891, vol. ii, sec. 125) employed the testicular fluid in five cases of phthisis, and, after giving the remedy a fair trial, saw no permanent benefit and abandoned the treatment.

A number of others have used injections of the orchitic fluid in the treatment of tuberculosis; some have praised and some have condemned it. The most sanguine seem to be able to allege for it nothing more than a tonic influence. How much of this is due to expectancy and the mental impression made upon the patient, and how much to the efficacy of the injections themselves, time and further experience must decide.

Cancer.—It seems strange that the orchitic fluid should have been tried in this disease, but it has, and marked systemic improvement, to say the least, has apparently followed its use. Brown-Séquard states: "To our utter surprise, an organic affection which we did not believe could be ameliorated is, on the contrary, the one of all kinds of disease which has given the largest proportion of ameliorations; that affection is cancer when located superficially. We knew in April last" (1892) "the effects of treatment in one hundred and three cases. If we put aside six cases in which death was impending, and was only delayed by treatment, there was considerable amelioration in the ninety-seven other cases. It consisted in the healing of ulcers, the cessation of pain, of insomnia, of hæmorrhage, of all appearances of cachexia, and of every other, except the presence of the tumour." In the *New York Therapeutic Review*, vol. ii, No. 2, p. 19, Paul Gibier reports two cases of cancer treated by the orchitic fluid, with marked improvement of the general health in both. Dr. Labrosse, of Algiers, has observed great improvement in the general health of his patients suffering from cancer on resorting to the Brown-Séquard method of treatment. Scepticism is excusable.

Leprosy and Skin Diseases.—Brown-Séquard observed ulcers heal in leprosy on the administration of the orchitic fluid. In the *British Medical Journal*, August 26, 1893, p. 474, occurs the following suggestive paragraph: "Dr. Symons Eccles cited a case of long-standing psoriasis in which injections of von Poehl's spermin appeared to be attended by marked amelioration, the severity and spread of the disease being distinctly checked. If von Poehl was correct in attributing the therapeutic value of spermin to its action as an oxidizing agent, it might be that all the animal extracts now employed depended on the existence of an oxidizing ferment in them. The influence of spermin on the leucomaine tide was very marked, and he hoped that observations on this point in regard to thyreoid and other extracts would be forthcoming."

Diabetes Mellitus.—Brown-Séquard gave the preference to the orchitic fluid over the pancreatic extract in the treatment of diabetes mellitus. Paul Gibier has treated two cases of this disease with alternate injections of nervous matter (from the cortex of the sheep's brain), the pancreatic, and the orchitic extracts. In the first there was no diminution of the quantity of sugar excreted, although the general health of the patient improved.

Chorea.—Brown-Séquard, commenting upon the orchitic liquid being more effectual in the treatment of organic disease of the nervous system than in the pure neuroses, remarks: "Chorea, however, forms an exception, as demonstrated by the success obtained by Professors Ollier and Tissier and a great many other practitioners." Deydier reported in *Lyon médical*, April, 1892, five cases of severe chorea treated and cured by the orchitic fluid after other means, including antipyrine, had failed. In the first, several injections were required; in the second, forty; in the third, eleven; in the fourth, eighteen; in the fifth, thirteen. (*New York Therapeutic Review*, vol. i, No. 4, p. 102.)

Colrat (*Lyon médical*, March 26 and April 16, 1893) has treated several cases of chorea with the orchitic fluid. One patient who had been affected with the disease for six weeks and was still unable to be out of bed, although he had been treated with antipyrine, was able to sit up after the first injection and to walk about a week later. Of two others, one required five, and the second six weeks' treatment. It does not seem that much can be alleged for the orchitic fluid in any of Colrat's cases, except possibly the first, and in this the cure was so sudden that it makes one suspicious of hysteria.

Epilepsy.—The consensus of opinion seems to be that the orchitic fluid increases the severity and number of the attacks in epilepsy. Paul Gibier has reported a number treated by injections of the orchitic fluid, and in each there was an increase of the severity of the malady. Féré, one of the ablest of the French neurologists, at the solicitation of d'Arsonval, gave the orchitic fluid a thorough trial in epilepsy at the Bicêtre Hospital, Paris. His report was made to the Société de biologie in 1893, just four years after Brown-Séquard announced the wonderful effects of this fluid, and in no uncertain language he gave his unqualified disapproval of this method of treating epilepsy. In no case was a favourable result observed, but, on the contrary, the injections seemed to act as a depressant. Dr. Bourneville and Dr. Paul Cornet (*Progrès médical*, Dec. 9 and 16, 1893) reported thirty cases of epilepsy treated by subcutaneous injections of testicular juice, and in none was there any marked improvement. Only twenty-eight of the thirty remained sufficiently long under treatment to test this method fairly, and in eight there was a slight diminution in the number of seizures, while in twenty there was a decided increase in the number of spells. (*Journal of Nervous and Mental Disease*, July, 1894, p. 479.)

Neurasthenia.—Nearly every one who has experimented with the orchitic fluid has given it a trial in this troublesome affection. A few have reported excellent results. In America, Paul Gibier and Hammond are quite sanguine of its beneficial and permanent effects in the neurasthenic. Both of these writers seem to prefer the combined or alternate injections of testicular fluid and nervous matter (cortex of sheep's brain). It does seem that if the orchitic fluid has a decided tonic effect it ought to be indicated in neurasthenia. I have tried preparations formerly manufactured by Parke, Davis, & Co., and those manufactured by the Columbia Chemical Company, but, besides a slight and temporary stimulating effect, which patients have frequently described as a sense of flushing, I have been unable to observe any result from the treatment.*

Persons suffering from *nocturnal emissions*, *impotence*, *debility*, or *premature senility*, and children afflicted with *nocturnal incontinence of urine*, have been treated with injections of orchitic fluid with apparent benefit. We must, however, have a more extended trial with this agent in these cases before definite conclusions can be drawn.

Patients with *hysteria*, *hystero-epilepsy*, and *contractures* have been benefited by the use of the orchitic liquid, but it is in these cases that suggestion has its most potent influence. Dr. W. D. Waterhouse (*British Medical Journal*, Jan. 30, 1892, p. 229) has reported: "A woman, aged seventy-seven, who suffered from rigidity and contraction of the left arm following an attack of apoplexy five years before. The rigidity almost at once relaxed, and she has been able to use the hand and arm ever since, now six months." He gave brief accounts of two other cases, one of which was evidently organic disease of the cord. Both patients recovered under hypodermic treatment with the orchitic fluid. We often forget that many patients with undoubted organic trouble become decidedly hysterical, and that the most obtrusive symptoms are of the latter nature. Charcot showed that these persons might be greatly benefited by suggestion.

Administration and Dose.—The preparation made according to the d'Arsonval method acts more readily and effectually when given subcutaneously, but for the nervous and timid, to whom hypodermic injections are objectionable, considerable effect may be obtained by dropping the liquid, about twice the quantity used in the subcutaneous method, on the tongue and requesting the patient not to swallow for half an hour, so that it may be absorbed from the mouth without coming in contact with the fluids of the stomach. I have over and over again tested this method of administration, and patients have told me that the sensations were about the same as when the medicine was given them under the skin. The effects are not quite so prompt or decided, but often more prolonged. I must repeat what I have expressed before, that, if the testicles are found to be an aid in the treatment of disease, rectal administration of the juice of the crushed glands will be found to be the most popular, especially by physicians living at considerable distances from large cities, unless it is positively demonstrated that the fluid may be kept for several weeks without deteriorating. The daily dose of the preparation made according to the d'Arsonval method varies, when given subcutaneously, from 1 to 3 cubic centimetres (from 16 to 48 minims). It is a glycerin preparation and should be diluted with two or three parts of water, to prevent irritation. The dose by the mouth, the liquid being allowed to be absorbed without reaching the stomach, should be at least twice that given by the subcutaneous method, and the dose by the rectum twice that given by the mouth. When the glycerin extract is given by the rectum the precaution must be taken to mix with it one or two ounces of water to prevent its irritating the bowel.

Thyreoid Extract.—The thyreoid extract has proved to be of so much importance as a therapeutic agent, especially in myxœdema, that a short account of its history may be of

* Since this paragraph was written I have tried the orchitic and brain extracts obtained from the Pasteur Institute, of New York, in one case of neurasthenia with apparently negative results.

interest. It had been known for some time that total destruction of the thyreoid gland would cause a peculiar cachexia, known as cachexia strumipriva, and that this condition was the more marked the younger the subject in which the gland was totally destroyed, when Schiff found in the dog that transplantation (intraperitoneally) of the healthy gland shortly after the operation of thyreoidectomy was sufficient to protect the animals from the fatal cachexia. Later, von Eiselberg conducted elaborate experiments, and found that if the transplanted gland underwent atrophy and degeneration the usual cachexia supervened, but if it became vascularized and resumed its function, no cachexia occurred. In 1883 Bircher reported his experiments in the transplantation of the thyreoid for the treatment of cachexia strumipriva, or acute myxœdema (Volkmann's *Sammlung klin. Vorträge*, No. 357). Kocher tried thyreoid grafting in 1883, but the gland atrophied. He performed the operation five times, and one patient improved. Victor Horsley, without being aware of Bircher's experiments with the thyreoid in acute myxœdema, suggested the treatment of ordinary myxœdema by means of transplanting the thyreoid gland from the sheep. Lannelongue, Merklen, Walther, Bettencourt, and Serrano performed the operation in cases of myxœdema and sporadic cretinism (*British Medical Journal*, Feb. 8, 1890, and Jan. 30 and Feb. 6, 1892). Bettencourt and Serrano, in 1890, placed half of a sheep's thyreoid beneath the skin in the thyreoid region of a patient suffering from myxœdema. Improvement began in twenty-four hours, and soon the red corpuscles increased to normal, speech improved, perspiration returned, and the menstrual flow, which usually had lasted three weeks, ceased in four days. On account of the improvement in the case just mentioned being manifest on the day after the operation, Vessale reasoned that it could not be due to the gland becoming vascularized and functionally active, but it must be owing to the absorption of the juice of the transplanted gland, and he therefore made intravenous injections of the thyreoid extract of a dog into a dog after thyreoidectomy with beneficial results. G. R. Murray (*British Medical Journal*, 1891, vol. ii, p. 797) reported results of his treatment of a case of myxœdema by means of subcutaneous injections of the thyreoid extract of a sheep. The improvement in this case was well marked.

The disadvantages of having to inject animal extracts under the skin are apparent, especially when it is not always possible for physicians residing at long distances from cities to obtain fresh extracts without a great deal of trouble. The credit of having first begun the administration of the thyreoid extract by the mouth for the treatment of myxœdema seems to be due to Professor Howitz, of Copenhagen. In March, 1892, he treated a woman suffering from myxœdema with pies made of calf's thyreoid. The improvement was prompt and decided. On June 2, 1892, Dr. E. L. Fox, of Plymouth, England, without any knowledge apparently of Professor Howitz's trial with the thyreoid gland, directed a patient of his suffering from myxœdema how to prepare a glycerin extract of half a sheep's thyreoid, somewhat after the manner that Dr. Murray had recommended. She was to take one half of this quantity an hour before breakfast and the remainder an hour before supper, and to continue doing so twice a week. Improvement in this case was pronounced, and perceptible soon after the treatment was begun. Curiously, Dr. Hector W. G. Mackenzie, of London, in apparent ignorance of the administration of the thyreoid gland by the mouth by Howitz and Fox, on July 27, 1892, began the treatment of a case of myxœdema of several years' standing by administering in one day two pounded sheep's thyreoids. The next day two drachms of a glycerin extract were given. During the last two years several manufacturing chemists, both in Europe and in America, have placed upon the market tabloids and dried extracts of sheep's thyreoid which may be kept for an indefinite time and are apparently as effectual in the treatment of myxœdema and other affections for which the thyreoid gland has been employed as the fresh juice of the gland.

But little is known of the effects of the administration of the thyreoid gland or its extract to persons in health (*British Medical Journal*, Dec. 9, 1893, p. 1267). Most of our knowledge of the influence exerted by the thyreoid gland comes from observing the effects following thyreoidectomy, the conditions accompanying deficient functional power of the thyreoid gland, and the changes that take place on administering the gland to persons whose thyreoid gland is absent or defective.

Victor Horsley (*British Medical Journal*, Jan. 30 and Feb. 6, 1892), in his masterly review of the function of the thyreoid gland, divides the symptoms following thyreoidectomy into neurotic, myxœdematous, and cretinic, these taking place in the order named. Following thyreoidectomy the symptoms are acute and profound and soon result in death, especially in young subjects. In disease of the thyreoid the symptoms come on gradually, and a condition known as myxœdema takes place. Through the loss of the modifying effects of the secretion of the thyreoid gland on the blood, the central nervous system and the nutritive functions are affected in disease of this gland. We seem to be justified in concluding that insufficient thyreoid secretion causes a degeneration in the nerve elements of the central nervous system, especially in the cortex of the brain and in the centres of the medulla; marked changes in the blood, probably from toxæmic influences; and pronounced nutritive changes, best observed in the subcutaneous tissue, where a substance called mucin is often deposited. The skin is greatly altered, and it becomes rough, coarse, dry, and inelastic. The hair turns gray and falls out. In acute myxœdema following thyreoidectomy the temperature may rise several degrees, while in the chronic form it is not infrequently below normal. Owing to the deposit of mucin in the subcutaneous tissue, the emaciation which would otherwise be well marked is not observed. Hæmorrhages, probably due to blood

changes, frequently take place from the mucous surfaces of the body.

Owing to the profound disturbances which follow extirpation or disease of the thyreoid gland, the gland or an extract made from it has been tried in several diseases.

Myxœdema.—The positive beneficial results of the use of the thyreoid gland or its extract in the treatment of myxœdema are too numerous and the failures too few for us to hesitate to employ this agent in combating a hitherto irremediable disease. Before the days of the use of the thyreoid extract or thyreoid feeding all that the best clinicians had to offer for the comfort of those suffering from myxœdema was protection of the patient from cold. In the *Medical Record*, October 7, 1893, Dr. Francis P. Kinnicutt, of New York, tabulated eleven cases of myxœdema treated by thyreoid grafting, with improvement in six and failure in five; and fifty-one cases treated by thyreoid injections or feeding, with improvement in forty-seven, no result in two, and failure on the part of the writer to report the result in two. I have since enlarged this list to one hundred and sixteen cases, with absolute failure to secure improvement in only three cases, leaving one hundred and thirteen out of one hundred and sixteen improved. Reports vary in regard to the degree of improvement. Some give the results as cures, while others say great improvement, the patient considering herself well, and a few record slight improvement. Where the condition of the thyreoid gland is such that its functional activity is permanently below the requirements of health, a permanent cure of myxœdema by the use of thyreoid feeding or injection is out of the question. We may conceive it possible, and even probable, that a condition of myxœdema may develop from impaired function of the thyreoid gland, and that this function, in the absence of organic change in the gland, may be re-established under the stimulus of thyreoid ingestion, while the myxœdematous condition is disappearing. The cases of myxœdema reported cured from the thyreoid treatment are comparatively few in number, and it is probable that sufficient time had not elapsed when the reports were made to justify such a conclusion. Experience seems to teach that cases of myxœdema relieved by the thyreoid treatment will relapse when the treatment is discontinued, so that to insure the best results it is probable that the treatment will have to be continued in a modified form throughout the patient's life. Improvement manifests itself within from a few days to a week or two after beginning the treatment, and continues for several months. It consists in increase of muscular strength, loss of weight, with a return of the natural appearance of the face and extremities, improvement of the voice, a fresh growth of hair in bald places, desquamation of the dry epidermis, with apparently normal cutaneous nutrition, a rise of temperature to normal, increased force and frequency of the heart's action, return of the blood to a normal condition, and brightening of the intellectual faculties, with improved mental vigour.

The unpleasant effects of the thyreoid treatment—such as headache, lassitude, nausea, vertigo, and sharp increase of temperature, with rapid pulse, so frequently observed by many—may be greatly modified, if not entirely avoided, by gauging the dose according to the tolerance of the patient. Some patients complain of pain in the limbs while taking the thyreoid extract.

Cretinism and Infantile Myxœdema.—Several cases of this variety of myxœdema have been successfully treated by means of the thyreoid extract. One of Osler's cases, reported in abstract in the *Medical Record*, July 21, 1894, p. 85, was that of a boy aged four years and eight months. In the early part of the treatment he took one quarter of the thyreoid gland of a sheep each twenty-four hours; later the gland was given him in a desiccated form. In fourteen months the boy grew four inches, an unusual increase. At the time of the report he walked and ran about, and had gained so much mentally that few would think him "queer." The myxœdematous appearance was all gone. Numerous other cases of cretinism or infantile myxœdema have been treated by means of the thyreoid extract and feeding, and with equally good results. As this is the only agent that apparently does any good in this form of myxœdema, it should receive a thorough trial in every case, but we must be prepared for less uniformly successful results in infantile than in adult myxœdema. Here, too, as in the adult form, the treatment must be continued from time to time during the life of the patient. If thyreoid grafting should prove to be satisfactory, it will be the most desirable method by which to combat infantile myxœdema.

Exophthalmic Goître.—In the *British Medical Journal* for 1893, vol. ii, p. 1192, Owen, of Manchester, reported a case of exophthalmic goître treated by thyreoid feeding with benefit. The case has been quoted by numerous English and American writers as an example of the good effect of the thyreoid treatment in exophthalmic goître, a condition supposed to be the opposite to what is found in myxœdema. Numerous trials of thyreoid feeding have been made since in exophthalmic goître, but so far I have been unable to find another favourable report.* Dr. Hector W. G. Mackenzie (*British Medical Journal*, July 21, 1894, p. 157) states: "The case" (Mr. Owen's) "was one in which a man was said to have had, by mistake, a quarter of a pound of thyreoid gland for two days running. As the weight of an individual gland is only about 90 grains,† it seemed to me that possibly a mistake had arisen on the part of the butcher, and that the patient had not had thyreoid gland at all. On my writing to Mr. Owen, he very kindly reinvestigated the subject, and found that, at any

* Voisin reports a case of exophthalmic goître in which benefit followed the use of thyreoid gland, and Bruns reports twelve cases of goître of the parenchymatous variety, in nine of which the patients were cured or improved by the administration of thyreoid gland. (*Medical News*, Dec. 8, 1894, p. 636.)

† This estimate is too light for the weight of a sheep's thyreoid gland.

rate in the first instance, it was not thyroid gland that the patient had had." Experience seems to justify the conclusion that thyroid feeding in exophthalmic goître is not beneficial, but, on the contrary, according to some observers, it increases the unpleasant symptoms of the disease.

Skin Diseases.—To Byrom Bramwell is due the credit of having first used thyroid feeding for the cure of certain diseases of the skin. It does not seem to have been a chance experiment with him, but, to use his own words in his first communication on the subject (*British Medical Journal*, 1893, vol. ii, p. 933): "I was led to treat cases of psoriasis by thyroid feeding not merely as a matter of chance, but in consequence of observing the very definite effects which the remedy produces on the nutrition of the skin in cases of myxœdema and sporadic cretinism." He began treatment with the thyroid extract in his first case of *psoriasis* on February 4, 1893, and within six days decided improvement had taken place. By May 3d the eruption had entirely disappeared. Two months after treatment was discontinued the eruption began to reappear. The treatment of two other cases reported by Bramwell in the same communication was equally successful. Dr. Arthur T. Davies, following the suggestion of Bramwell, soon after the latter's early experience with thyroid feeding for certain diseases of the skin, reported four cases—two of *psoriasis*, one of *ichthyosis*, and one of *chronic eczema*—which had been greatly benefited by the administration of thyroid tabloids. The case of ichthyosis and one of the cases of psoriasis were entirely cured by means of the tabloids; the other two cases were considerably improved. After the results of Bramwell's experience with thyroid feeding in certain skin diseases were made known, numerous trials were made with various preparations of sheep's thyroid for the relief of chronic and more or less intractable skin affections, and for a time it seemed that a great advance had been achieved in the management of these diseases; but, if we are to be guided by further observations and riper experience, hopes have been raised which are destined to disappointment. At the meeting of the American Dermatological Association held in Washington in May, 1894, Dr. George Thomas Jackson, of New York, in his paper on thyroid feeding in diseases of the skin, stated that he had treated three cases of *xeroderma*, one of *ichthyosis*, and one of *dermatitis exfoliativa* with the powder of desiccated thyroid in gelatin capsules. Four of the patients had experienced unpleasant symptoms from the use of the thyroid preparation. There had been some improvement in the condition of the skin, but no cures. Including the author's five cases, there had been reported up to May 1, 1894, thirty-eight cases of skin diseases treated by thyroid feeding, with eleven cured, fourteen improved, and thirteen unchanged.

In the discussion which followed the reading of Dr. Jackson's paper, Dr. Hartzell and Dr. Stelwagon reported negative results, and Dr. Hyde gave his experience with the use of thyroid feeding in ten cases of *psoriasis*, in which two of the patients had shown decided improvement, two had been made very ill, and the six others had derived no benefit. It seemed to be the prevailing opinion of the members of the association that we had little to hope for from the use of the thyroid gland in the treatment of skin diseases. At the same meeting Dr. Corbett stated that the English physicians were about ready to give up the use of this new remedy in cutaneous diseases, with the exception of *lupus vulgaris*, where, it was thought, benefit was derived from its use.

Insanity.—Thyroid feeding has been recommended in various forms of insanity attended with depression, and especially in *melancholia*. I am not aware that it has had an extended trial in any cases of mental disease except when associated with myxœdema. Here, as a rule, the mental symptoms improve with the physical, but Dr. F. C. Shattuck, of Boston, reports a case in which melancholia developed during the thyroid treatment. It should be remembered, however, that in this case there was no improvement in the myxœdematous condition except in the nutrition of the skin.

Syphilis.—In the *British Medical Journal*, December 2, 1893, p. 1192, there is found under the head of Eye-Piece: "Is there any existing record of cases where thyroid extract proved beneficial and curative in patients suffering from obstinate secondary and tertiary syphilides? I have noticed that marked desquamation and a healthy action of the skin was induced by this treatment. A case of very severe rupia, with extensive ulcerations of the legs and scalp, which resisted all unknown remedies, has commenced to improve." Other cases are referred to in the same note, and in all the ulcers had shown a tendency to heal (commencing on the third day) when the patient was placed upon the use of thyroid extract. Ten grains of the powdered extract of the gland, given in the form of tabloids, were administered thrice daily. Dr. J. Duncan Menzies (*British Medical Journal*, July 7, 1894, p. 12) reports four cases of "*malignant Indian*" *syphilis* treated by thyroid extract, with apparently decided benefit. The author thinks that the administration of thyroid gland alone in syphilitic subjects is attended with good results, and adds: "I am inclined to regard the remedy as a powerful skin tonic and adjuvant to the mercurial and alterative treatment of syphilis."

Obesity.—A properly constructed dietary with regulated exercise is undoubtedly the best and safest means of reducing superfluous fat, and in many cases this is all that is required. Dr. N. E. Yorke-Davies believes that "in certain conditions of the blood, as where it does not seem to have the power of oxidizing the waste of the system, they" (the tabloids of thyroid extract) "are a valuable adjunct." Certainly his tables show a very much more rapid reduction of weight when the thyroid extract was administered in connection with a regulated dietary than when the latter alone constituted the treatment.

On account of the increased metabolism and the improved condition of the blood following the ingestion of the thyreoid gland, especially in myxœdema, the thyreoid extract has been suggested as an aid in the treatment of *anæmia.*

The analogy between the thyreoid gland and the pituitary body, and the frequency of disease of the latter in *acromegaly*, is probably the reason why some have suggested the use of thyreoid feeding in this disease.

Dose and Administration.—Since it seems to be pretty well established that the active principle of the thyreoid gland is not destroyed by the juices of the stomach, there is no occasion for administering the glycerin extract hypodermically. Probably the best, and certainly the most available, preparation of the thyreoid gland is the dried extract, which may be given in the form of tabloids or in gelatin capsules. The dose to begin with should be small—2 or 3 grains thrice daily, and gradually increased to 5 or 10 grains, as the tolerance of the patient and the demands of the case seem to indicate.

Pancreatic Extract.—The earliest reference that I find advocating the use of pancreatic juice in *pancreatic diabetes* is one made by Dr. R. Mansell-Jones, of Brighton, in which he suggests that it might be used with benefit in these cases, as the pancreas is often disordered in this affection. Dr. Neville Wood (*British Medical Journal*, Jan. 14, 1893, p. 64) reports two cases of diabetes treated without success by the pancreatic extract. Dr. Hector W. G. Mackenzie (*ibid.*, p. 63) reports two cases of diabetes treated by ½ fl. oz. of *liquor pancreaticus* administered thrice daily, immediately after meals, with some apparent benefit to the strength and general health of the patient, but the quantity of the sugar was not affected. In the two cases of diabetes treated by Paul Gibier by alternate injections of pancreatic extract and nervous matter, in one there was no effect on the quantity of sugar eliminated, and in the second the sugar disappeared and the patient was much improved (*New York Therapeutic Review*, vol. ii, No. 1, p. 20). W. Hale White, as a result of treating two cases of diabetes mellitus by means of raw pancreas and liquor pancreaticus hypodermically, expresses a doubt whether the disease can be modified by this means (*British Medical Journal*, March 4, 1893). In the same journal for March 18, 1893, W. Knowsley Sibly says that he thinks he has produced some benefit in diabetes mellitus by feeding his patients on raw pancreas, and in the issue of June 17, 1893, W. A. Willis reports a case of diabetes mellitus treated with raw pancreas, in which there was little or no improvement. Several others have tried the pancreatic treatment for this disease, usually, however, with indifferent results.

Nervous Substance. — Constantin Paul (*Bull. de l'Académ. de méd.*, 1893, No. 17, p. 445), W. A. Hammond (*New York Medical Journal*, Jan. 28, 1893, p. 93), Maréchal (*Presse médicale belge*, May 8, 1892), Babes (*Dtsch. med. Woch.*, July 28, 1893), Dana (*Boston Med. and Surg. Journal*, May 18, 1893), Paul Gibier (*New York Therapeutic Gazette*, vol. ii, No. 2), and others have employed preparations made from the spinal cord and brain cortex, usually of the sheep, in the treatment of various forms of functional and organic nervous disorders. According to most of the observers mentioned, glycerin extract of nervous matter, introduced hypodermically, acts as a stimulant in exciting the heart to increased vigour in contracting and in improving the condition of the digestive apparatus, resulting in improved nervous tone and relief of *insomnia.* Constantin Paul employed brain extract in fifty-three cases of *neurasthenia*, with alleged improvement in all except those in which the patient was suffering from hysteria, melancholia, or hypochondriasis. The most marked beneficial effects were noticed in the digestive functions, in ability to sleep, and in the patients' becoming amenable to other forms of treatment from which they had failed to derive any apparent benefit before beginning the hypodermic administration of nervous matter. Hammond records similar results. Babes and Paul Gibier report decided effects from the hypodermic use of brain and cord substance in *epilepsy.* Babes alleges cures of cases of epilepsy from this treatment, while Gibier is modest enough to record improvement only. Dana urges a more extended trial with the animal extracts of normal tissues and organs, and with ferments and blood serum, apparently more on account of the effect of these substances on toxic agents which may be causing irritation than on any supposition of the animal substances' having any direct curative action on the diseased processes. He relates a case of *bulbar paralysis* apparently cured and six cases of *tabes dorsualis* treated with brain extract, with improvement in two, which improvement was not manifest while injections of water were being given, but became apparent soon after brain extract was substituted for the water. Paul Gibier has used the brain and cord extracts quite extensively, and reports good results from this new treatment.

It is premature to pass judgment on this plan of treatment. Most of us are prejudiced against it, but we should wait for more extended observations before condemning it. The difficulty of obtaining suitable preparations and the inconvenience of using the extracts hypodermically are obstacles to their general use. If they are beneficial on account of their antitoxic properties, it is probable that the juices of the stomach and small intestines will destroy these, but they have been used with apparent benefit by the lower bowel, and preparations for this mode of administration can be made by any one with ease.

Dose and Administration.—Babes took normal brain and spinal cord and made them into an emulsion with broth in the proportion of 1 part of nerve tissue to 5 parts of broth, and of this he injected from 4 to 5 c. c. (60 to 75 minims) into the abdominal wall or the flank five or six times a week in epileptics and four or five times in neurasthenics. If hypodermic injections are used, it is better that they should

be made of known strength in the d'Arsonval apparatus, and of this glycerin extract from 2 to 3 c. c. (30 to 45 minims) may be used daily or several times a week. If the rectum is the channel of administration, the bowel should be thoroughly cleansed, and an extract made from the brain or cord by means of water with the addition of a little glycerin, which has been allowed to stand for a few hours, or, better, one or two days in a cool place, then filtered through paper, may be thrown well up into the rectum.

Spleen extract has been recommended to be used hypodermically in leucocythæmia, enlarged spleen, and *Hodgkin's disease;* **suprarenal-capsule extract** in *Addison's disease;* **pituitary-body extract** in *acromegaly;* **thymus extract** in cases in which the thyreoid extract is indicated; **kidney extract** in cases of *deficient action of the kidneys;* **bone-marrow extract** in *anæmia;* and **muscle extract** in *muscular dystrophies;* but no definite and positive results have been reported from their use, with the possible exception of the extract of bone marrow.

Extract of Bone Marrow.—Dr. J. Dixon Mann (*Lancet*, March 10, 1894, p. 599) states that he has seen good results follow the ingestion of bone marrow by the stomach in cases of *anæmia* and of *oligæmia* due to loss of blood from such causes as placenta prævia, hæmorrhoids, and wounds. As the bones of young animals are the richest in red marrow, he thinks these are preferable. His method of preparing and giving the marrow is as follows: "To prepare the extract the heads of the long bones, obtained from recently killed animals, with other portions of bone which contain red marrow, are broken into small pieces and digested in glycerin with frequent agitation. When the extraction is complete—several days being required—the extract is filtered off and is ready for use. It is red or reddish brown in colour and is devoid of any unpleasant taste or odour. It may be given in teaspoonful doses once or twice a day either out of the spoon or spread between thin pieces of bread."

Tuberculin.—On November 14, 1890, Koch announced in the *Deutsche medicinische Wochenschrift* (Epitome of the *British Medical Journal* of the same date) a remedy for tuberculosis. It was a brownish, transparent liquid which, according to the author, did not readily decompose. At that time Koch stated that his researches were not completed, and he was therefore not prepared to make known the origin and mode of preparation of the remedy.

When this liquid was injected into a healthy person, decided reaction followed, attended by pain in the limbs, fatigue, cough, dyspnœa, and rise of the body heat, but it was found that a dose sufficiently small to be scarcely appreciated by a healthy person gave rise to pronounced symptoms in tuberculous subjects, with a rise of temperature far in excess of that which followed a larger dose administered to a person in health. The local effect on *lupus*, *tubercular diseased glands*, *joints*, etc., was decided. On account of the greater reaction which followed the administration of the remedy to tuberculous subjects, it was early recognised that in this liquid we had a means of diagnosticating tuberculosis in doubtful cases in the lower animals. An influence was exerted upon lupus and tuberculosis, and a large number of physicians were eager to try the new remedy.

On January 15, 1891 (*ibid.*), Koch announced that the new remedy was a glycerin extract of a pure cultivation of tubercle bacillus. We are told that the active principle was extracted from the bacilli by a forty- to fifty-per-cent. solution of glycerin. Reports of thousands of cases of *tuberculosis* treated with Koch's tuberculin were soon forthcoming, with results varying from cures to death. In the *Year-Book of Treatment* (1892, p. 55) 1,191 cases of various forms of tuberculosis treated with tuberculin were recorded, with eleven cures—certainly a small percentage of cures had they been left without any treatment, especially when we take into consideration that 242 of the patients were in the early stage of pulmonary tuberculosis. A number of excellent and conscientious observers were able to report many cases which had seemed to be decidedly benefited by the tuberculin treatment, but it became apparent that much harm was resulting from the extensive use of tuberculin. In many cases the reaction following the introduction of the agent resulted in speedy death, while in others the treatment seemed to cause the spread of tubercular processes to other portions of the body.

On October 22, 1891 (*ibid.*), Koch, in a communication, gave the results of experiments with a purified form of tuberculin, the dose of which, according to Ehrlich (*Lancet*, 1891, vol. ii, p. 917), varies from 0·1 to 0·5 milligramme, although where hectic exists only from 3 to 5 decimilligrammes several times daily are recommended. Ehrlich maintains that the method of treatment first adopted was wrong in that the doses were too large, so that violent reaction and depression of the recuperative powers of the tissues resulted.

In a report issued from the Brompton Consumption Hospital (*Lancet*, 1892, vol. i, p. 41) it is stated "that the tuberculin did not favourably influence the course of the disease in the majority of cases, that in some the effects were detrimental, and that even in the stationary and improved cases it was difficult to ascribe any distinct improvement to the injections."

After a careful study of the reported results obtained by the use of tuberculin in tuberculosis, one is forced to the conviction that its beneficial influence, at best, is never very pronounced, and that, unless the remedy is employed with considerable judgment and discretion, harm may follow its use.

The uniformly favourable influence of tuberculin on *lupus* observed on the first employment of this agent raised hopes which have been disappointing, as the disease is found to recur in many cases after the use of the injections is stopped, and sometimes it has returned with increased virulence.

Dose.—The dose to begin with should not exceed 0·1 milligramme, and this should be increased by 0·1 milligramme at each administration until 1 milligramme is reached, when the dose may be increased more rapidly. The precaution observed by Dr. Karl von Ruck, of Asheville, N. C., is not to repeat the use of the remedy until twenty-four hours have elapsed after all signs of irritation from the previous dose have subsided. The dose must be cautiously increased as the tolerance of the patient is established.

Rabies treated with Spinal-cord Emulsion.—On July 4, 1885, Pasteur began a series of inoculations on the person of Joseph Meister, employing spinal-cord emulsions prepared from animals which had succumbed to rabies. During 1884, Pasteur had demonstrated that it was possible to modify rabies in the lower animals by means of inoculation. By methods suggested and practised by Pasteur the virus of rabies may be attenuated or intensified. The longer the medulla taken from an animal dead of rabies is allowed to dry, the more attenuated the virus becomes, so that medullary substance that is allowed to dry for fourteen days loses much of its virulence. Intensified virus of rabies may be obtained by a series of inoculations from animal to animal. An emulsion of the medulla taken from an animal dead from "street" rabies is placed under the cerebral dura of a living animal, which soon dies from the disease, and from this animal the medulla is injected into a second animal, in which the disease develops more rapidly, runs a shorter course, and shows greater malignancy than in the first. By means of repeated animal-to-animal inoculation the virus soon becomes so intensified as to give rise to "paralytic rabies."

In employing inoculation for the prevention of hydrophobia in a man bitten by a rabid animal, Pasteur begins by injecting an emulsion from a spinal cord fourteen days old (dried), and on each subsequent day an emulsion from the cord dried one day less than that used on the previous day, until the virus is reached only two or three days removed from the strength of ordinary "street" rabies. It seems to be conceded by the majority of experimenters with rabies that the disease can be prevented in the lower animals and in man by using the Pasteur method of inoculation soon after the subject is bitten by a rabid animal. It must be remembered that some contend that it is possible to communicate hydrophobia by inoculation with the attenuated virus.

Statistics of the Pasteur Institute of Paris from 1886 (the time of its foundation) to 1892, inclusive, show 12,782 persons treated, with 68 deaths, making the death rate 0·52 per cent. It is stated that the great majority of persons who have been treated at the Paris Pasteur Institute were bitten by dogs which have been examined by veterinary surgeons and recognised as rabid (*N. Y. Therapeutic Gazette*, vol. i, p. 93). In 1892, 104 persons were treated for the prevention of hydrophobia in the New York Pasteur Institute. Forty-seven of these had been bitten by animals whose rabies was assured by experimentation or by the death of persons or animals bitten by them; 42 were persons wounded by animals whose rabietic condition had been recognised by clinical or veterinary examination; and 15 were persons injured by animals whose disease was only suspected. No deaths are reported among the 104 persons thus treated.

Inoculation against Rabies by the Method of Tizzoni and Centanni.—Tizzoni and Centanni (*British Medical Journal*, 1893, March 11, p. 516) profess to have extracted from the central nervous system of rabid animals a principle for inoculation against rabies. With this substance they succeeded in every case in rendering rabbits proof against even subdural infection. They propose to communicate hereafter the method by which the principle is obtained. The virus is extracted from the central nervous system of a rabbit which has died from the effects of the intensified virus (*virus fixe*), although they state that the virus taken from a rabbit of the first generation has given positive results. The material is a watery liquid of a very light straw-colour, readily absorbed, and 10 c. c. represent about 1 gramme of the nervous tissue. It has the advantage over the antirabietic virus of Pasteur that it is without any harmful action, local or general, and will not communicate hydrophobia.

Fourteen animals were treated: Three received 40, 30, and 25 c. c. of the solution respectively, in divided daily doses extending over a period of fourteen days. Eight animals were treated for eight days, and received 30, 30, 20, 15, 15, 10, and 7 c. c., distributed in daily doses; one was treated for five days and was given 20 c. c. in five equal doses each day; one was given 20 c. c. at one dose. All were inoculated with the virus (injected under the cerebral dura) of "street" rabies on the day after the final "vaccination," and at the same time six healthy animals not "vaccinated" were inoculated with the same virus of "street" rabies. The results were as follows: The six "control" animals died between the fifteenth and twenty-first day after infection; twelve of the "vaccinated" animals were living and healthy five months later; and the two remaining animals died. The one that had received only 7 c. c. during a period of eight days died on the fifteenth day, and the one that had been given 10 c. c. in the same length of time died on the twenty-second day.

For curative effects the treatment by "vaccination" must be begun not later than the fourth day after infection has taken place; the sooner the treatment is instituted after infection the greater the probability of a cure; and the dose must be larger for curative than for preventive "vaccination." For the former purpose not less than 40 c. c. should be employed for a rabbit, given in divided daily doses extending over a period of from six to eight days, and for the latter 15 c. c. should be the minimum quantity.

Cholera Inoculation.—To Dr. Jaime Ferran, of Barcelona, is due the credit of first

introducing a method of anticholeraic inoculation. It was found that by this method an animal might be rendered proof against hypodermic injections of cholera virus, yet that it would succumb when the poison was injected into the intestinal canal, and, further, that there was danger of spreading the cholera poison. Dr. Haffkine's method of "vaccination" against cholera seems to be superior to Ferran's in every respect, and the one introduced by Klemperer has apparent advantages over Haffkine's.

Haffkine renders the system tolerant of cholera poison by injecting attenuated cultures, prepared by growing them in media aërated by air at a temperature of 39° C. [102·2° F.], and then employs an intensified or exalted culture made by carrying the poison from animal to animal until its virulence is many times stronger than that of ordinary Asiatic cholera. One objection to this method of anticholeraic inoculation is the reaction which sometimes follows its use. Klein (*British Medical Journal*, Mar. 25, 1893, p. 632), endeavours to show that Haffkine only uses the intercellular poison developed from cholera culture, and not the true toxine of the comma bacillus. Haffkine is at present (July, 1894) in India, employing his method of anticholeraic "vaccination," and in the *British Medical Journal* for July 7, 1894, p. 25, we find a report of forty-eight persons, belonging to four families, of whom twenty-one were "vaccinated" against cholera, and twenty-seven were not. Of the "unvaccinated," seven, or 33·3 per cent., suffered from cholera, while none of the twenty-seven "vaccinated" were attacked. (See also *Boston Medical and Surgical Journal*, Aug. 23, 1894, p. 201.)

Serum Therapy in Cholera.—Klemperer conferred immunity on guinea-pigs by accustoming them to the living, dead, or attenuated virus, which he administered either subcutaneously or by the stomach, having first rendered the gastric secretion alkaline. In contradistinction to Haffkine, he always used bouillon cultures from twenty-four hours to three days old, which presumably contain the specific toxine. The animals were refractory against any form of inoculation—intraperitoneal, gastric, or subcutaneous—after such treatment, and their serum was subsequently highly protective.

To man he gives subcutaneous injections of bouillon cultures, from twenty-four hours to three days old, which have been kept heated for two hours to 70° C. [158° F.]. The initial dose is 0·1 c. c., the maximum 1 c. c. He gives altogether about 3·5 c. c., divided into from six to eight doses, administered in from ten to twelve days. The general and local reaction is said to be insignificant. Three days after giving the last injection he tested the "immunizing" power of the blood serum of man by injecting it into a guinea-pig, which was found to be resistant against large doses of virulent cholera bacilli. He succeeded in rendering his own blood serum strongly protective by taking into his stomach large quantities of warmed cultures of cholera bacilli, having first rendered the contents of the stomach alkaline.

Serum Therapy in Diphtheria.—Behring, Wernicke, Kossel, Kitasato, and others have experimented with an antitoxine to the poison of diphtheria, but as yet results do not seem to be satisfactory. The sheep has been employed, and serum in large quantities is thus obtained. George F. Still (*British Medical Journal*, July 28, 1894, p. 180) reports one case treated by Schering's antitoxine. The case seemed very grave and tracheotomy appeared to be necessary, but, on giving 11 minims of the antitoxine hypodermically, the improvement was prompt and decided. The next day 8 minims were given, and the child was soon out of danger. The thirty cases of diphtheria treated by Behring and the eleven by Kossel by means of "normal diphtherial therapeutic serum" do not give any gratifying results. (*Year-Book of Treatment*, 1894, p. 190.)

Still more recent reports from Berlin physicians on the treatment of diphtheria with "immunizing" blood serum are more encouraging. The *Medical Record* for September 1, 1894, quotes from the Berlin correspondent of the *Journal of the American Medical Association* the statement that Professor Ehrlich, Professor Kossel, and Dr. Wasserman, of Berlin, have published a paper on the application of a curative serum invented by Professor Behring, an assistant of Professor Koch's. Behring had undertaken to confer on animals immunity from the diphtheritic poison, and then to get a serum from the blood of those animals by which he hoped to protect human beings against the results of diphtheria, as well as to cure the disease when already developed in an individual. Ehrlich, Kossel, and Wasserman have followed Behring in his experiments, and they always intended to use the results of their experiments for curative purposes. They experimented on goats. Two hundred and twenty patients with diphtheria were treated with the serum. Of these there were cured 168, or 76·4 per cent.; 52 died. Tracheotomy was performed on 67 patients, of whom 30 died; the rest recovered. But a true insight into the curative effects of the injections is gathered, says the correspondent, only by grouping the diseased persons according to the time that had elapsed between the infection and the beginning of the treatment. He then gives the following table:

Duration of disease at time of beginning the treatment.	Treated.	Cured.	Died.	Percentage of cures.
First day	6	6	....	100
Second day	66 (9 tracheotomies)	64 (7 tracheotomies)	2 (2 tracheotomies)	97
Third day	29 (8 tracheotomies)	25 (7 tracheotomies)	4 (1 tracheotomy)	86
Fourth day	39 (14 tracheotomies)	30 (10 tracheotomies)	9 (4 tracheotomies)	77
Fifth day	23 (10 tracheotomies)	13 (4 tracheotomies)	10 (6 tracheotomies)	56·5

The foregoing shows the importance of instituting the antitoxine treatment of diphtheria early in the disease, when the best effects are accomplished by its use. In the *Boston Medical and Surgical Journal* for August 30, 1894, p. 225, Dr. Cyrus Edson, of the New York City Health Department, speaks enthusiastically of the efficacy of the antitoxine treatment of diphtheria, and says that, on the strength of the testimony of Dr. Hermann M. Biggs, chief of the bacteriological bureau of the department, who had spent nine months in Berlin in studying the treatment, he has decided to ask from the authorities "an appropriation of $30,000 for the establishment of an experimental station for the manufacture and dissemination of the antitoxine." * [See the articles on ANTITOXINES and on SERUM THERAPY, and, for Klebs's treatment of diphtheria, the article on ANTIDIPHTHERINE.]

Serum Therapy in Tetanus.—The bacillus of tetanus was first discovered by Nicolaier. Rosenbach, a few months later, obtained a like germ from the secretions of a wound of a patient suffering from tetanus. Kitasato, a Japanese student in Koch's laboratory, isolated the germ, and by inoculating this in pure culture produced the disease in animals, and established the identity of the Nicolaier soil bacillus with that of Rosenbach taken from the wound of a person suffering from tetanus.

To Behring and Kitasato is due the credit of first demonstrating that animals can be rendered proof against tetanus. The serum of animals thus rendered insusceptible to the poison possesses a strong antitoxine effect on the poison of tetanus, so that one part of such serum will destroy thirty parts of the poison. Roux and Vaillard, whose investigations with the blood serum on the poison of tetanus, both in the lower animals and in man, carried on in the Pasteur Institute in Paris, enable them to speak with some authority, profess to be able to preserve the serum indefinitely after it has been dried *in vacuo*, by keeping it dry. On using it, six parts of distilled water are added to dissolve it.

Both man and the lower animals can be rendered proof against tetanus, but, while the immunity sets in within a few hours after the first injection, it is uncertain how long it may last.

In the treatment of tetanus in man, the sooner the antitoxine serum is administered after the disease becomes apparent the more probably will success be obtained, but even then the action of the serum is not so certain as when it is given before symptoms are apparent. It has been suggested by Roux and Vaillard that small doses might be administered as a preventive of the disease in persons suffering from wounds likely to be followed by tetanus. According to the investigators just mentioned, the blood of an average-sized man may be rendered antitoxic by injecting from 100 to 150 c. c. of prepared serum.

For the treatment of tetanus they recommend the following: "Excision of the wound and injection at once of 100 c. c. of active serum; next day and the following day repeat the injection of 100 c. c., and continue it daily so long as any symptoms last" (*Year-Book of Treatment*, 1894, p. 447). It must be borne in mind, however, that the antitoxine serum, while it neutralizes the poison in the blood, does not destroy the germs at the original seat of the disease, and, unless this source of reinfection can be removed, the disease may at any time return. To guard against such untoward results, it has been proposed to keep up the antitoxine injections for ten or twelve days after all symptoms of the disease have subsided.

It is well known that, while certain animals and fowls are refractory to tetanus, their blood serum will not destroy the toxine of tetanus, but that after injecting pure cultures of tetanus poison into such naturally refractory animals, their blood serum acquires strong antitoxine powers against tetanus, and may then be used to render other animals proof against the disease. The blood serum of artificially protected animals is capable of destroying the toxine of tetanus.

Serum Therapy in Hydrophobia.—Babes, of Bucharest (*Lancet*, 1891), experimented with the blood serum of dogs rendered proof against hydrophobia. Spinal-cord emulsion does not seem to give the usual protection against hydrophobia to those bitten by rabid wolves, and Babes used antitoxine blood serum on twenty-seven dogs thus bitten, with the result that three died, two having symptoms of the disease before the injections were begun, and twenty-four recovered. It would seem from these experiments that it is possible for blood serum to protect in certain cases when spinal-cord emulsion is powerless.

Tizzoni and Schwarz conclude (*Riforma medica*, 1891) "that the serum of 'vaccinated' rabbits can destroy the activity of the virus of rabies, retaining the power for some days if kept at a low temperature. Besides this, it distinctly confers immunity not only against subcutaneous, but also against intravenous and subdural inoculations." The experiments on dogs were less satisfactory. (*Annual of the Universal Medical Sciences*, 1892, vol. iii, M–5.)

Serum Therapy in Typhoid Fever.—Chantemesse and Widell (abstract in *New York Therapeutic Gazette*) found it a comparatively easy matter to protect rabbits against typhoid fever, and to stop the disease in infected animals with the serum taken from animals thus treated, yet when the same treatment was applied to man, except for a slight lowering of the temperature, the disease ran its usual course.

* Since this paragraph was written the results of numerous trials with the antitoxine of diphtheria have become familiar to all who have interested themselves in this subject. The demand for large quantities of serum from animals rendered proof against diphtheria has led to the selection of the horse for this purpose. It requires several months' treatment of the horse, by injecting from 20 to 30 c. c. of a culture of the toxine of diphtheria three or four times a week, before the serum possesses sufficient antitoxine power to be trustworthy in the treatment of diphtheria in the human subject. It takes, too, about a month to prepare the toxine culture which is to be used on the horse.

Serum Therapy in Tuberculosis.—The experiments of Semmola with the serum of the dog in the treatment of tuberculous disease have not been very gratifying, while C. Richet and Roger seem to think the local trouble and the general health were improved and the virulence of the bacilli was lessened. Dogs are refractory to aviary tuberculosis, but not to human tuberculosis. Héricourt has demonstrated the fact that, if dogs are "vaccinated" with a culture of aviary tuberculosis, they become proof against human tuberculosis, and their blood serum then possesses an antitoxic power against the human form.

Serum Therapy in Syphilis.—Fenlard has employed bichloride of mercury dissolved in the serum of the dog in the proportion of 1 to 2,000, and of this he gives three or four teaspoonfuls in milk, but the reports do not show results to commend this method of treatment. The sheep and calf are said to be refractory to the poison of syphilis. Tommasoli and Pellizzari have treated syphilitic subjects with injections of the blood serum of these animals, using from 4 to 8 c. c., and profess to have been able to cure the secondary syphilitic manifestations in a fortnight in every instance. They encourage the hope that in serum therapy we shall ultimately find a sure cure for syphilis.

Serum Therapy in Influenza.—The experiments of Bruscheltini on animals are interesting. With a culture made with the microbe of this disease he conferred immunity against influenza, and found that the serum from "immunized" animals possessed marked curative properties. Should these results be verified, this method of treatment of influenza in the lower animals alone will prove of inestimable value to stock-raisers.

Serum Therapy in Anthrax.—To Ogata and Jasuhara, of Tokio, seems to be due the credit of having discovered that the blood serum of an animal rendered proof against anthrax possesses properties antitoxic to the bacilli of anthrax. Emmerich (*Münch. med. Woch.*, July 10, 1894; Epitome of *British Medical Journal*, July 28, 1894) relates some interesting results in serum therapy in the treatment of anthrax.

Serum Therapy in Pneumonia.—During 1893 H. Audeond, Klemperer, Foà, Scaria, Janson, Netter, and Patella made known the results of numerous experiments with serum therapy in pneumonia (*Year-Book of Treatment*, 1894, pp. 41, 42), but we must wait for further developments before much advance in the treatment of pneumonia by this method over older ones can be accepted.

Great care is necessary in the preparation of the serum, so that every step of the procedure may be thoroughly aseptic. When the animal's blood-vessels are sufficiently large, a sterilized pipette is inserted into one of them, and after the desired quantity of blood is collected the pipette is sealed by heat. The serum is allowed to separate from the coagulum at a low temperature, when microscopical examinations and culture tests are made to insure freedom from all infecting germs. When the animal's blood-vessels from which it is desired to obtain blood are too small to allow of the insertion of a pipette into them, the blood is allowed to flow into a sterilized vessel. After the serum has separated, it is sterilized, preferably by the d'Arsonval apparatus.

Serum therapy has received so much attention from able experimental investigators during the past few years, and the principles on which it is based seem so logical and scientific, with the promise of practical results, that it is with regret I am compelled to devote so small a space to it. [For further consideration of this subject, see the articles on ANTITOXINES and on SERUM THERAPY.]—J. T. ESKRIDGE.

ANISE, ANISEED, *anisum* (U. S. Ph.), *anisi fructus* (Br. Ph), *fructus anisi* (Ger. Ph.), is the dried fruit of *Pimpinella Anisum.* It is a stimulant stomachic by virtue of its volatile oil, the *oleum anisi* of the pharmacopœias. The *aqua anisi* of the U. S. Ph. is made by triturating 2 c. c. of oil of anise with 4 grammes of precipitated calcium phosphate, gradually adding 1,000 c. c. of distilled water, and filtering; that of the Br. Ph., by distilling 1 gallon from a mixture of 1 lb. of bruised anise fruit and 2 gallons of water. From a tablespoonful to a wineglassful of this preparation may be given at a dose. The dose of oil of anise is from 2 to 6 drops on sugar, or well diluted with water. The *spiritus anisi* of the U. S. Ph. is made by mixing 1 part by bulk of oil of anise and 9 parts of deodorized alcohol. The dose of this preparation, commonly called *essence of anise*, is from 10 to 30 drops. The *teinture d'anis* of the Fr. Cod. is made by macerating 1 part of anise fruit in 5 parts of alcohol for ten days, with occasional agitation, expressing, and filtering. The dose is from 5 to 15 drops, on sugar. An extemporaneous hot infusion of anise, prepared by steeping from 2 to 10 parts of anise fruit in 1,000 of boiling water, may be taken freely in attacks of *colic*. Star anise, *anisum stellatum*, is the fruit of *Illicium anisatum* (see ILLICIUM).

ANNIDALIN.—Iodized phenol, $C_6H_3I_3O$, a proprietary amorphous, violet-red powder obtained by the action of iodine on phenol in the presence of an alkali. It is odourless, insoluble in water, but readily soluble in ether, benzene, or chloroform. It has been used as a substitute for iodoform.

ANODYNES.—See ANALGETICS.

ANODYNINE.—See ANTIPYRINE.

ANTACIDINE.—Calcium saccharate.

ANTACIDS are remedies used to neutralize an excess of acidity in the secretions of the alimentary canal or to check acid fermentation of the food. As commonly understood, they consist of the alkaline bases and their carbonates and oxides. *Wood charcoal* is sometimes included in this class on account of its property of absorbing large volumes of gases.

The antacids most commonly used are *sodium bicarbonate*, *lime water*, and the *oxides* and *carbonates of magnesium*. A very popular proprietary preparation consists of from 3 to

5 grains of sodium bicarbonate, 1 to 2 grains of ammonium carbonate, and a small amount of oil of peppermint, compressed into tablets of varying size known as "*soda-mints.*" The effect of this class of remedies is simply to neutralize temporarily the acidity present in the alimentary canal, but their continued use for this purpose is not desirable, as they soon aggravate the condition they are intended to benefit. The states in which they are indicated are *pyrosis* with acid eructations, *aphthous sore mouth*, *colic*, and *acid diarrhœa*, and they are best administered after eating, in combination with carbonic-acid water. (Cf. Alkalies.)—Russell H. Nevins.

ANTAGONISTS are agents which, in their physiological action, oppose each other or oppose disease, and may be employed against each other, or against diseases, to *counteract* their effects upon the living organism. Such agents have been designated *physiological antidotes* by some writers. They are either substances or measures, and may be subdivided into (*a*) *toxicological antagonists* and (*b*) *therapeutical antagonists*, according as they are employed against each other or against disease. The *substances* employed as antagonists are generally the active principles of plants, a few being chemicals (such as oxygen and chloral), or animal products (such as vaccine, tuberculin, etc.), while the *antagonistic measures* include all such procedures as artificial respiration, faradization of the respiratory muscles, constant motion or absolute repose, heat, cold, douching, etc.

Antidotes, on the other hand, are agents which alter the chemical or physical characters of poisons and thereby *prevent* their toxic action upon living animal tissues. (See under Antidotes.) Antidotal action takes place in the alimentary canal or in the respiratory passages before the absorption of the poison, and is available against mineral as well as vegetable poisons, but not against poisons which have been administered hypodermically. Antagonism takes place in the blood and tissues after absorption of both the poison and the antagonist, it is available against poisons administered hypodermically, as well as by other channels, and, so far as drugs are concerned, it is applicable chiefly to vegetable poisons or to those which produce their effects after absorption.

Thus, for *poisoning by digitalis* the *antidote* is tannic acid, which forms with the active toxic principle of the drug a chemical compound (tannate) which is almost insoluble and therefore comparatively innocuous. But, as it is not entirely inert, an *antidotal measure*—viz., evacuation of the stomach—must be employed, by the administration of zinc sulphate or any other emetic, or by the use of a stomach-pump. If, however, the patient is not seen until a dangerous quantity of the poison has been absorbed, antidotes will be of no service except against such portion of the drug as is still in the stomach, and the following *antagonists* should be employed to counteract the effects of what has been absorbed—viz., aconite or morphine against the cardiac action, the former for the effects of large doses, the latter for those of the long-continued use of the drug. Saponin and senegin are the most complete antagonists against digitalis, their counteraction extending throughout nearly its entire range of action. Alcohol is also indicated as a cardiac stimulant, and among the *antagonistic measures* the recumbent posture is one of prime importance, by reason of the liability to sudden cessation of the lowered cardiac action on the patient's assuming the erect posture.

In most cases of poisoning by vegetable principles absorption has proceeded so far before professional assistance is obtained that antidotes are of no value, and reliance can be placed only upon the physiological antagonists and such antagonistic measures as may support vitality until the poison can be eliminated by the excretory organs of the body. There may be an exception in the case of morphine, which, after making the round of the circulation, constantly returns in part to the stomach until it is eliminated, so that the ingestion of potassium-permanganate solution from time to time may have a continuous antidotal action on such portion of the poison as may have been absorbed.

Physiological antagonism means a balance of opposed actions on particular organs or tissues, which actions (or derangements) may be excited by medicinal agents and measures or by disease. Their antagonism may extend throughout the whole or the greater part of their range of action, or, as is usually the case, be limited to a few points thereof. There are no instances in which the antagonism of two drugs is absolutely complete along their whole line of action. In a few it is nearly so, as with morphine and atropine (except as to narcosis), digitalis and saponin, and atropine and muscarine, the latter being considered the most complete known. In most cases the antagonism extends only to certain definite spheres of action, and the antagonists may be synergists to each other in other spheres, as in the narcosis produced by both morphine and atropine. It may be local, affecting a single organ or function, or may extend to a group of organs, to several associated functions, or over the distribution of the nerves proceeding from a certain nerve-trunk (such as the vagus) or nerve-centre. Again, antagonism implies a balance of functional disturbance, not an alteration of structure.

Drugs are rarely antagonistic to each other in the same degree, but, by reason of differences in their mode and time of action, the action of one preponderates over that of the other, so that the latter will not counteract the former to the extent of averting a fatal result, though in the reverse order their counteraction may be most satisfactory. For example, while chloral is the antagonist to strychnine, opposing the spinal action of the latter drug, the reverse is true to a very limited extent; and, while atropine may prevent death from a lethal dose of aconitine, morphine, or bromal hydrate, no one of these three will do so in atropine poisoning.

Two mutually antagonistic principles may exist in the same plant, such as the alkaloids pilocarpine and jaborine in pilocarpus, and the glucoside constituents of digitalis, one of which, digitonin, antagonizes the actions of the three others, digitalin, digitoxin, and digitalein.

Toxicological antagonism is a very old idea in medicine. Mithridates the Great, of Pontus (B. C. 164–'24), and other monarchs of the heathen world occupied themselves with the study of poisons and their antidotes and antagonists, established botanical gardens for the purpose of their investigation, and gave their names to what were supposed to be universal preventives against the results of poisoning. Mithridatics and alexipharmacs were the names of such, and they were in use to the period of the Middle Ages. In the sixteenth century Prosper held that theriaca (opium) was an antagonist to all poisons. From 1570 to 1677 many observations were made and published on the treatment of belladonna poisoning by opium, and in 1810 the same matter was made the subject of an inaugural thesis by Lipp. The scientific investigation of drug action and antagonism was not possible until the discovery and isolation of the alkaloids, but followed immediately thereon, and was begun in 1809 by Magendie upon the upas poison (nux vomica) and its newly discovered alkaloid, strychnine. In 1869 Schmiedeberg and Koppe made their researches on muscarine and atropine, and Liebreich discovered chloral and proved the antagonism of strychnine against its action, the converse of which was shown by Bennett in 1875. In 1870 Frazer published his investigations upon atropine and physostigma, and Preyer his on the antagonistic influence of atropine and hydrocyanic acid on respiration. In 1875 a committee of the British Medical Association made an extended investigation and report on the antagonism of several drugs, which was supplemented by the work of Vulpian on atropine and pilocarpine in the same year, that of Fothergill (1876–'78) on aconite, atropine, and digitalis, and that of Huseman, in 1877, on the antagonisms of chloral. Much good work has also been done in England by Brunton and Ringer, and in the United States by Wood and Bartholow, on the same lines. The name of Brunton is unalterably associated with the antagonism between amyl nitrite and the spasmodic paroxysm of angina pectoris, a discovery in therapeutic antagonism which was made by him through the exercise of purely scientific reasoning. Bartholow has collected a list of 120 cases of poisoning by opium and belladonna, each treated with the other as an antagonist, in which 15 proved fatal, or 12·5 per cent.

The most important instances of drug antagonism, so far as elucidated, are set forth in the following synopsis, in which the active principles of plants are designated rather than the plants containing them, except in a few instances:

Atropine and morphine are antagonistic in their action on *respiration*, atropine stimulating, morphine depressing it, and this is the most valuable point in their antagonism: on the *pupil*, atropine dilating it by stimulation of the sympathetic and paralyzing the motor oculi, morphine contracting it by stimulating the motor oculi, the action of atropine preponderating and lasting much longer; on the *heart*, atropine quickening it, morphine slowing it, the action of atropine preponderating; on *arterial tension*, atropine raising it, morphine depressing it after a brief rise; on the *kidneys*, atropine promoting, morphine decreasing the renal activity; on the *brain*, in medicinal doses, atropine exciting, causing active congestion, insomnia, hallucinations, and busy delirium, morphine depressing (except in small doses), causing passive congestion and correcting the cerebral symptoms produced by atropine, both producing coma and narcotism when used in excessive doses; as to *general symptoms*, atropine correcting the coldness, sweating, cerebral nausea, etc., produced by morphine.

Morphine kills by causing failure of respiration; atropine counteracts this tendency and tends to maintain the activity of the respiratory function. Atropine proves fatal by exhausting the irritability of the cardiac motor ganglia, the vasomotor system, and the respiratory centre through overstimulation: morphine, by lessening the work of the heart and lungs, opposes these effects.

Atropine and muscarine present the most complete instance of physiological antagonism. On the *brain*, atropine causes hyperæmia and active delirium, muscarine produces anæmia and intoxication; on the *pupil*, atropine dilates and muscarine contracts it; on *salivation*, atropine arrests it, and muscarine promotes it; on the *heart*, atropine quickens and restores its action when arrested by muscarine, which slows and stops it in diastole; on *respiration*, atropine stimulates and muscarine paralyzes it.

Atropine and pilocarpine present one of the most exact cases of antagonism. On the *eye*, atropine dilates the pupil, paralyzes the accommodation, and renders the subject presbyopic, while pilocarpine contracts the pupil, causes spasm of accommodation, and approximates the near and far points of vision; on *secretion*, especially of the sweat and saliva, atropine arrests and pilocarpine promotes it; on the *heart*, atropine stimulates and pilocarpine slows and enfeebles it; on the *arterial tension*, atropine raises and pilocarpine depresses it.

Atropine and physostigmine (eserine), on the *pupil*, *respiration*, and *secretion*. The antagonism of atropine against physostigmine acts within narrow limits, but sufficiently to be of use in poisoning by physostigmine, the converse being doubtful.

Atropine and quinine.—On the *heart*, atropine stimulates and restores action arrested by quinine, which stops it in diastole; on the *arteries*, atropine dilates and quinine contracts them; on *blood-pressure*, atropine retards and quinine raises it, as observed in frogs and rabbits.

Atropine and bromal hydrate.—On the *blood-vessels*, which atropine contracts (?) and

bromal dilates by paralysis of the sympathetic; on *salivation*, atropine arresting and bromal promoting it. Atropine may save life after a lethal dose of bromal, but the reverse is not true.

Atropine and chloral.—On the *brain*, atropine excites it, causing hyperæmia, while chloral is hypnotic, producing anæmia; on the *spinal cord*, atropine exalts reflex excitability and causes a tetanizing action, while chloral suspends the reflexes and causes spinal paralysis; on *respiration*, atropine stimulates and chloral depresses it; on the *vaso-motor centre*, atropine stimulates and chloral depresses it. Atropine is antagonistic to chloral in much greater degree than chloral is to atropine. Both produce motor paralysis.

Atropine and aconitine.—On the *heart* and *respiration*, which are stimulated by atropine and depressed by aconitine.

Atropine and phytolaccine.—On the *heart*, which phytolaccine arrests in diastole by paralysis of its motor ganglia and muscle, while atropine stimulates the accelerator nerves and the motor ganglia; on *sensation*, phytolaccine lessens it; on the *spinal cord*, phytolaccine paralyzes it; on *respiration*, which phytolaccine depresses. Atropine antagonizes all these effects. (Observed in twenty experiments on animals by Bartholow.)

Chloral and picrotoxin.—On the *brain* and *spinal cord* they are antagonistic, including the reflex, motor, and sensory functions of the cord, but not on the heart and respiration, which both drugs paralyze.

Chloral and heat.—Dr. Lauder Brunton found that an animal kept wrapped in cotton-wool might recover from a dose of chloral sufficient to kill it if exposed to the cooling action of the air.

Digitalis and aconite have an antagonism limited to their action on the *heart*, which, when paralyzed and distended by aconite, recovers its contractile power slowly under digitalis. The reverse action is not so marked. These drugs have widely different rates of diffusion and elimination, and digitalis, being the slower, must be given from five to nine hours before aconite for them to exhibit their antagonistic action. (Observed on frogs and rabbits by Fothergill.)

Digitalis and muscarine or **aconitine,** on the *heart*, digitalis stimulating inhibition, and thus paralyzing it, muscarine restoring cardiac movements by relaxing the grip of inhibition. (Boehm.)

Digitalis and saponin or **senegin.**—Saponin or senegin arrests the *heart* in diastole, while digitalis stimulates contraction. The heart, if arrested by saponin or senegin, is restored to action by digitalis, and *vice versa*. (Köhler.)

Morphine and aconite, on the *heart* and *respiration*, which morphine stimulates and aconite depresses. Morphine has repeatedly saved life in cases of poisoning by aconite.

Morphine and caffeine (also **cocaine, theine,** and **guaranine**) are antagonistic on the *spinal cord*, the *heart*, and *sensation*, but synergistic on the *brain* and the *vaso-motor system*. Strong infusion of coffee is an empirical antagonist to the effects of morphine poisoning.

Morphine and chloroform or **ether** are synergistic as to anæsthesia, but antagonize each other in their action on the *heart* and *respiration*, morphine stimulating and supporting them and chloroform and ether depressing them. The combined use of morphine with chloroform or ether for anæsthesia is safer than the use of these anæsthetics alone. (Bernard.)

Opium and gelsemium.—Opium, in ordinary medicinal doses, antagonizes gelsemium, which acts like *Veratrum viride* (see below). Opium has saved life in several cases of *poisoning with gelsemium.*

Opium and Veratrum viride, the former in medicinal (not toxic) doses.—On the *heart* and *respiration*, opium maintains, while veratrum depresses the heart and paralyzes respiration; on the *vaso-motor system*, opium stimulates it, raising arterial tension, and veratrum depresses it, lowering arterial tension; on the *body temperature*, opium raises and sustains it, and veratrum lowers it; on *secretion*, opium diminishes it, and veratrum increases it; on the *brain*, opium stimulates it, and veratrum produces anæmia; on the *spinal cord*, opium stimulates and veratrum depresses the motor functions. These agents have high rank as mutual antagonists in efficiency, extent of range, and *vice-versa* action. In several cases of poisoning with opium life has been saved by veratrum (Bartholow).

Strychnine and aconitine.—Strychnine has a stimulating and aconitine a paralyzing action on the muscles of *respiration*. A lethal dose of aconitine is entirely overcome by strychnine in twice the lethal dose. (Observed on animals by Fothergill.)

Strychnine and amyl nitrite.—On *respiration*, strychnine stimulates the muscles, and amyl nitrite paralyzes them; on the *spinal cord*, strychnine stimulates the reflex function, and amyl nitrite suspends it; on the *heart*, strychnine decreases its action, and amyl nitrite increases it greatly; on *arterial tension*, strychnine stimulates it, and amyl nitrite depresses it greatly.

Strychnine and chloral.—On *respiration*, strychnine stimulates the centre, producing tetanic fixation of the muscles, while chloral depresses the centre and removes tetanic fixation; on the *spinal cord*, strychnine exalts the reflex and motor functions, while chloral suspends both; on the *circulation*, strychnine stimulates the vaso-motor centre, and chloral depresses it; on the *brain*, strychnine increases the circulation, while chloral causes cerebral anæmia. Chloral is more decidedly antagonistic to strychnine than strychnine is to chloral. The antagonistic quantities are $\frac{1}{96}$ of a grain of strychnine and 15 grains of chloral. Seven cases of strychnine poisoning treated with chloral, all successfully, have been recorded (Bartholow).

Strychnine and chloroform or **ether.**—Ether given by inhalation in poisoning with strychnine has proved successful in ten report-

ed cases (Bartholow). Anæsthetics suspend the exalted sensibility and reflex excitement due to the action of strychnine, and maintain functions which would otherwise be exhausted by overstimulation. Conversely, strychnine in the dose of $\frac{1}{10}$ of a grain, hypodermically, antagonizes the cardiac and respiratory depression produced by these agents, though atropine will do so more quickly.

Strychnine and nicotine are antagonistic in their action on the *spinal cord* and the *respiratory muscles.* Nicotine was proposed as an antagonist to strychnine in cases of poisoning by Haughton, of Dublin, in 1862, but has been superseded by chloral. Strychnine is antagonistic to and curative of the effects of nicotine on the heart and vision, caused by excessive tobacco smoking.

Viscum album (mistletoe) is a cardiac tonic, exalts the vascular tension, and diminishes sensation. Its antagonists are the cardiac and respiratory depressants, especially aconite and *veratrum viride* (Bartholow).

The following table, modified from Brunton, gives the antagonistic poisons, also their mutual antagonistic and lethal doses, in grains to the pound weight of the animal:

ANTAGONISTS. I.	II.	LETHAL DOSE. I.	LETHAL DOSE. II.	ANTAGONISTIC DOSE. I.	ANTAGONISTIC DOSE. II.
Aconitine and	atropine	$\frac{1}{900}$	?	$\frac{1}{750}$	$1\frac{3}{5}$
" "	digitalin	$\frac{1}{900}$	1	$\frac{1}{600}$	$\frac{2}{5}$
" "	strychnine	$\frac{1}{900}$	$\frac{1}{288}$	$\frac{1}{750}$	$\frac{1}{125}$
Alcohol and	strychnine	....	$\frac{1}{288}$	....	....
Atropine and	aconitine	?	$\frac{1}{900}$	....	....
" "	chloral	?	?	....	....
" "	hydrocyanic acid	?	....	....	....
" "	jaborandi	?	....	....	....
" "	muscarine	?	....	....	....
" "	morphine	?	3	....	....
" "	pilocarpine	?	....	....	....
" "	phytolaccine	?	....	....	....
" "	physostigmine	?	$\frac{1}{25}$	....	....
" "	quinine	?	$1\frac{1}{4}$	....	....
Bromal hydrate and	atropine	$\frac{1}{900}$	?	....	....
Chloral and	atropine	?	?	....	....
" "	picrotoxin	?	....	....	....
" "	physostigmine	?	$\frac{1}{25}$	....	....
" "	strychnine	?	....	....	....
Chloroform and	amyl nitrite	?	....	?	$\frac{1}{300}$
Digitalin and	aconitine	....	$\frac{1}{288}$	....	....
" "	muscarine	....	$\frac{1}{900}$	....	....
" "	saponin	....	....	....	....
Gelsemium and	opium	$\frac{1}{6}$	$\frac{1}{20}$	$\frac{9}{56}$	$\frac{1}{20}$
" "	atropine	3	?	3	$\frac{3}{7}$
Morphine and	caffeine	$\frac{1}{3}$	$1\frac{3}{4}$	$\frac{1}{3}$	....
" "	chloroform	....	....	....	....
Muscarine and	atropine	....	....	....	....
Opium and	atropine	....	?	....	....
" "	gelsemium	....	?	....	....
" "	veratrum viride	....	....	....	....

Under the titles of the various poisons, OPIUM, NUX VOMICA, etc., throughout the book, the antidotes and antagonists for each are treated of, together with such antidotal and antagonistic measures as are most suitable.

Therapeutical antagonists include all agents or measures which counteract the effects of particular diseases, and may be employed against them in accordance with the law of contraries. This was laid down by Hippocrates in several aphorisms, notably that in which it is stated that "Some diseases are cured by contraries, some by similars"; also by Fernel (sixteenth century) in a treatise on the maxim "Every disease must be combated by contrary remedies."

The antagonism between medicinal agents and disease has been recognised empirically from the earliest historical times, but was impossible of scientific elucidation until, with the discovery of the active principles of plants, the systematic study of their physiological effects began, early in the present century. The pioneers in this field were Magendie, who investigated the action of strychnine in 1809, and suggested its use against paralysis, and Fouquier, who first actually employed it in accordance with Magendie's deductions. Among later investigations, the most brilliant is that of Brunton upon the antagonism of amyl nitrite to the paroxysms of angina pectoris, already mentioned.

The most important instances of the treatment of disease by drugs having actions antagonistic to their effects are as follows: Strychnine against the *functional paralyses,* such as diphtheritic and reflex paralyses, asthma from *paralysis of the diaphragm,* and *depression of respiration.* Antispasmodics, such as chloroform, chloral, tobacco, the bromides, physostigma, and gelsemium, against the *spasmodic neuroses,* such as *tetanus, epileptoid convulsions, spasmodic coughs, hiccough, laryngismus stridulus,* etc. Amyl nitrite for the paroxysms of *angina pectoris* and *epilepsy.* Chloral, cimicifuga, conium, and morphine against *chorea.* Analgetics—such as aconite, gelsemium, and morphine—and anæsthetics, against *pain;* analgetics by interrupting transmission of the sensation to the centre, and anæsthetics by preventing its realization by the consciousness. Hypnotics, such as chloral, against *insomnia* and *acute mania.* Gelsemium, conium, hyoscyamine, and duboisine against *acute mania,* with illusions, hallucinations, and great motor activity. Morphine against *melancholia.* Aconite, veratrum, and the bromides against *acute cerebral congestion* of an active form; and digitalis, ergot, barium, and quinine against the passive form. Cerebral excitants, such as strychnine, atropine, and quinine, against *cerebral anæmia.* Digitalis and ergot against *exophthalmia.* Atropine against *weakness of the heart* from depression of its accelerator apparatus; digitalis for a weak, quick heart, due to relaxed inhibition. Ergot against *aneurism* and *hæmorrhage.* Digitalis, veratrum, the bromides, opium, etc., against *metrorrhagia, menorrhagia,* and other forms of *hæmorrhage.* Atropine and strychnine against *dyspnœa.* Atropine and morphine against *diarrhœa* and *dysentery.* Belladonna, nux vomica, and physostigma against *constipation* from intestinal torpor and deficient secretion. Atropine against *sweating, lactation,* and *salivation.* Digitalis and squill against *renal inactivity.* Ergot against *polyuria.* Quinine, morphine, digitalis, aconite, the salicylates, resorcin, and other antipyretics against *fever* and *inflammation.*

Morbific products of disease or bacterial life,

obtained by cultivation on living tissue and other media, were introduced by Jenner, Pasteur, and Koch, and are successfully employed as antagonists against variola, hydrophobia, and tuberculosis. They can only be referred to in this place, as their use forms a special system of treatment.

Animal products have been employed as antagonists to diseases, such as that from the thyreoid gland for myxœdema and testicular extract against disorders of senility; but the results thus far obtained are not sufficiently definite to admit of dogmatic teaching thereon.

SAMUEL O. L. POTTER.

ANTAPHRODISIACS.—In the *satyriasis, priapism,* and *nymphomania* due to insanity, idiocy, leprosy, and disorders or injuries of the central nervous system, probably all methods will fail of more than slight or temporary success, but where these elements are absent a greater or lesser degree of relief can be obtained, provided the patient will co-operate. The treatment consists largely in the use of moral measures. No matter what may be the apparent causes of these conditions, certain procedures are necessary in every case. These consist in the removal of every possible kind of irritation, no matter how slight, of the genito-urinary tract and the genital organs. The diet should consist as largely as possible of non-nitrogenous articles, alcoholic liquors and all condiments except salt being interdicted; the rectum should be kept free from any over-accumulations of fæcal matters; the urine should be rendered alkaline, as an acid urine always acts as an irritant of the urethra and increases its vascularity; intestinal worms, if they exist, should be expelled: and all local causes of irritation, such as eruptive disorders of the genitals in either sex and phimosis, paraphimosis, adherent prepuce, irritable urethra, etc., in the male, should be corrected by appropriate treatment. The clothing should be arranged so as to cause as little irritation of the genitals as possible, and the patient made to sleep on his or her side on a hard bed with just sufficient clothing to insure comfort, the foot of the bed, in bad cases, being at least a foot higher than the head, thus relieving or preventing pelvic congestion; and the sleeper should be roused at an early hour in the morning. As a precaution against young children acquiring the habit of self-abuse, it is desirable to begin as early as possible with them in the practice of sleeping with the arms outside of the bedclothes. By tying a towel around a person's body, with the knot behind, about on a level with the last dorsal vertebra, the habit of sleeping on the back may easily be broken up, as the instant the person turns over on to his back the knot will cause sufficient uneasiness or pain to rouse him. As a distended bladder causes erections in the male, it must be emptied before going to bed and early in the morning, or sometimes in the middle of the night, the patient being wakened for the purpose. In aggravated cases, due either to serious disease of the central nervous system or to the use of articles irritating to the genito-urinary tract, such as cantharides, it may be necessary to apply ice to the genitals until the irritation has somewhat subsided. This same method is entirely applicable in the treatment of *painful chordee.* It should be hardly necessary to state that all exciting influences, such as that of libidinous literature and pictures and association with loose women, must be removed. In men in whom a not excessive sexual erethism exists the constant association with virtuous women is an advantage. In the young a certain amount of physical restraint may be advisable, but as a rule such measures as infibulation and the attaching of the prepuce to the thigh by means of a silver wire have not been attended with much success. In *spermatorrhœa* and *immoderate nocturnal emissions* what is known as a spermatorrhœa ring will often lend aid to the patient in his desire to gain relief. This consists of a soft rubber ring in the inner circumference of which is concealed a sharp metallic point, so that when it is slipped over the flaccid penis it is not noticeable. When, however, an erection takes place the point presses into the penis and causes sufficient pain to wake the person, who can then make water, apply ice, or do whatever his own experience has taught him is best. A somewhat similar device is arranged to sound an electric bell upon the occurrence of erections during the night, but is rather complicated and has never met with much success. Daily cold baths and frequent affusions upon the genitals are valuable aids to whatever treatment may be undertaken. In aggravated conditions of *nymphomania* the propriety of ablation of the clitoris and labia minora may be considered, but such an operation is rarely allowable unless there seems to be no hope of success by less severe methods and when life or reason is threatened. One point which must not be overlooked in such cases is that of the condition of the ovaries, for in many instances their prolapse or morbid condition excites a most exaggerated sexual appetite. Their removal or restoration to their normal condition will, as a rule, relieve the other symptoms. The drugs which are most likely to be of use in the states just mentioned are camphor, its monobromide, the bromides of the alkaline bases, lupulin, conium, belladonna, and digitalis. Camphor, to be of any value, must be given in large doses; the bromides are best associated with camphor water, and such a mixture is practically identical with the monobromide. Veratrum viride and all nauseating drugs are used with some degree of success in the treatment of *chordee.* Malt liquors, on account of the hops they contain, are slightly antaphrodisiac, and tobacco has a feeble effect in the same direction, so that it is not advisable to suspend their use when aphrodisiac conditions are being combated. Lactucarium is credited with some antaphrodisiac virtues, but they are so slight as to be almost valueless. Belladonna is more especially indicated when there is priapism or an irritable bladder.—RUSSELL H. NEVINS.

ANTARTHRITICS are remedies against gout. See the articles on ALKALIES, ANTIRRHEUMATICS, COLCHICUM, GUAIACUM, LITHIUM,

Piperazine, Potassium iodide, and Salicylic acid.

ANTASTHMATICS are substances and agents which prevent, diminish, or abolish asthma. To complete the definition it is necessary to state the exact meaning of the word *asthma* as I here employ it. It is a term which, like many another one, has been used rather indiscriminately by medical writers, some limiting it to the indication of spasmodic dyspnœa; some extending its connotation so as to include any attack of dyspnœa, subjective or objective, which is of rapid development, without a distinct pulmonary lesion as its basis, and which subsides without any marked alteration in the condition of the respiratory apparatus; while almost all authors use it as a convenient term whose significance varies, and is at any particular time qualified by the subject upon which they are writing.

For general therapeutical purposes I shall define asthma as a derangement of the function of respiration characterized by dyspnœa which is not due to any diminution of the respiratory surface or to pulmonary congestion.

In other words, there is no hindrance to the diffusion of gases between the blood and the air, save in so far as the accumulation of carbonic oxide (CO_2) in the residual air increases the tension and makes the interchange less rapid. That is, however, a factor of no practical importance, as the slight difference between the rapidity with which the carbonic oxide (or acid) of the blood and the oxygen in the air effect their exchange of places under the fluctuating tensions which correspond to the phases of respiration would cause variations in the hæmoglobin so small that they might be ignored.

In ordinary breathing in the human subject the air loses only about 5 per cent. by volume of its oxygen. The meaning of this proposition is that if a certain quantity—say 100 cubic inches—of atmospheric air is drawn into the respiratory passages in a given inspiratory act, it will be found that the same volume of air taken from what is exhaled during the expiration immediately following has a different composition. It has now about 5 per cent. (or 5 cubic inches) less oxygen, and about 4·5 per cent. of it is carbonic oxide.

But the air which remains in the bronchial tubes and the alveoli of the lungs has a composition which is much more constant—indeed, it can vary but little when the body is quiescent, for this residual stratum of air stands as a medium between the gases of the respiratory capillary system and the tidal drift of the atmospheric sea as it ebbs and flows in the tubular channels. By this means the rate of diffusion is maintained at the same ratio, excepting as it is influenced by the blood-pressure and, to a very slight degree, by the fluctuation of the bodily temperature.

The volume of air contained in the respiratory system, from the rima glottidis above to the alveoli below, may be presented to the imagination as a cone the angle of whose vertical section is more than a right angle. If the cone were of such dimensions that the angle of its apex was a right angle, it would increase in size from above downward at the same rate as that at which a pencil of light does—viz., in direct proportion to the square of the distance. The surface illuminated at the distance of 100 miles from the sun is a hundred times that at 10 miles, though the distance is only ten times as great. This simple illustration may be useful to those whose mathematics is rusty. If the area of the trachea is a square inch, the alveolar surface would be, say, 150 square inches. But, in fact, the rate of expansion is far greater than that.

In true asthma the calibre of the bronchial tubes is lessened, either by contraction of their muscular coats or by swelling of the mucous membrane and submucous tissues. At the same time there is a secretion of viscid mucus which, clinging to the surface and being raised from it to some extent by the current of air, increases the obstruction.

In the larynx and trachea—probably in the larger bronchi also—there is no appreciable diminution of capacity.

As a result of these conditions the normal equilibrium between the influx and efflux of air is disturbed. While the inspired air flows easily from the narrow apex of the cone into its broad base, the outflow from the larger into the smaller space is not so free. This begets a tendency to the accumulation of air in the alveolar cavities.

I am personally persuaded that the time-honoured theory of the production of asthma by spasm of the circular muscular fibres of the bronchial tubes is not correct: but that the expiratory dyspnœa results from a vaso-motor aberration involving dilatation of the blood-vessels of the mucous membrane, swelling and diminution or even obliteration of the lumina of the tubes, and accumulation of viscid mucus.

Be this as it may, we have two pretty definite indications for the general treatment of asthma. One is the evident necessity of some action upon the nervous system. The agents used for this purpose are classed under the head of antispasmodics, though the exact nature of their action is not thoroughly understood, inasmuch as they are known to relieve abnormal conditions which do not correspond to our ideas of spasm.

It is quite possible that the vaso-motor changes, some of which are characterized by contraction and others by dilatation of the smaller blood-vessels, are all in reality due to similar reactive changes in the ganglion-cells, and may all be modified or controlled by agents which inaugurate the activity of these central nervous elements. There appears to me to be no valid objection to the theory that such drugs as diminish the constricting operation of certain parts of the vaso-motor system may, under different circumstances, also arrest the dilating function.

The second indication is to modify in some way the secretion of adhesive mucus, which has in all probability more to do with the causation of asthma than the other factors mentioned.

Antasthmatics, then, will be such agents as have a sedative effect on the vaso-motor nervous system, and such as have the power of changing the secretion of viscid mucus into the secretion of thin, non-adhesive mucus.

Inasmuch as the disturbance may be secondary, we have also to deal with a third problem —viz., that of ascertaining and removing the cause of these troubles.

Most of the cases of asthma are of *reflex* origin. The primary irritation is in the lungs themselves, in the larynx, in the naso-pharynx, in the nasal passages, in the tympanic region, in the circulatory apparatus, or in the digestive organs. When not of reflex origin, asthma is almost always caused either by a neurotic condition associated with epilepsy, hysteria, or some other grave dyscrasia, or by renal disease.

Though the list of causes is long, the distinction is seldom difficult. The examination is made in accordance with the principles stated. First, is it a case of asthma? This is easily determined by ascertaining that the dyspnœa is due to interference *mainly* with the expiration; that the breathing is *slow as compared with the intensity of the dyspnœa;** that there are sibilant and sonorous râles indicative of but little moisture; and that there is no evidence of disease in the pulmonary parenchyma, except, it may be, emphysema.

This being determined, an investigation of the upper air-passages, inquiry into the condition of the digestion, and a careful scrutiny of the personal history will enable one to state the nature of the case with much certainty.

In cases of neurotic inheritance it is important to search for a *zone*, as the neurologists say of epilepsy, or region from which the initial reflex may come.

We are now able to classify the antasthmatic resources as follows: 1. Means of combating the constitutional predisposition. 2. Means of overcoming the (so-called) spasmodic condition. 3. Whatever will do away with the source of a reflex irritation.

The constitutional predisposition is, as the expression indicates, something inherent in the individual which can seldom be eradicated entirely, but must be *combated*, as I have said.

In some instances, where the physician has the opportunity of beginning his treatment while the subject is still young—in infancy or childhood—and where, as the confidential and trusted adviser of the family, he is able to insist on a rational course of physical education, it is possible to influence the development of the organism in such a manner as to guide it slowly and steadily into the path of normal existence. We can always count on a "power which makes for (physiological) righteousness" —viz., the tendency of organized bodies to grow toward the anatomical and physiological type of their species, and, where there is some inherited deviation from that type, we may by judicious management enable the individual organism to overcome the evil tendency and to grow toward the average ancestral form. This is quite apparent in cases of genu varum, in which, as is well known, careful attention to health and avoidance of undue strain on the legs are usually sufficient to enable them, as the child develops, to assume the normal structure. Less apparently, but no less certainly, may an analogous result be accomplished in dealing with congenital or early acquired abnormities of the nervous, respiratory, and vascular systems. And nowhere is the opportunity of the family physician to do good more evident, or the result of his efforts more satisfactory, than in this particular department of practice.

The scope of this work does not allow me to do more than to indicate this very important division of the therapeutics of asthma.

The remedial agents for this predisposition are, aside from hygienic measures, tonics, alteratives, and the drugs which act especially as calmatives and roborants of the nervous system.

The means of combating the so-called spasmodic condition are *physical* and *chemical*.

Physical Means.—Regulation of temperature is one of the most important. The asthmatic, like all other nervous people, is very sensitive to changes of temperature. His room should be moderately warm—should have a temperature which is so regulated that he is not conscious of any sensation of heat or cold. From 60° to 65° F. will usually answer. The bedclothing should be very light, so as to preclude any feeling of oppression. It is often better to have him wear a full suit of light underclothing,* to which I have frequently and with great satisfaction made the addition of a light pair of socks basted on to the drawers. This allows of free motion without danger from uncovering the feet. In cool weather it is better to have a fire in the room and the windows open to secure free ventilation.

Another physical influence of great value—one which I have not seen suggested by any author—is *elastic compression of the chest.*

For this purpose I use a Martin pure *rubber bandage*, applied so as to make the slightest pressure compatible with its retention. In winding it about the chest it is stretched barely enough to have it tighten itself and cling to the surface. This will assist the expiratory efforts, prevent the excessive distention which usually occurs, and materially lessen the dyspnœa, which is largely due to inability to expel the normal amount of tidal air. It should not cause distress—at most a little discomfort —and should be used at first for five or ten minutes every hour. If well borne it may be kept on for half an hour, but the physician

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* It is not always or usually slower than normal respiration, as might be inferred from the statements of some authors—*e.g.*, Riegel—but it is much slower than would be expected where one is so short of breath. This is always the case in *labored breathing.*

* It is always better to have asthmatics, as well as those suffering from other chronic pulmonary diseases, wear light underclothing. They always perspire easily, and as our houses are almost as warm in winter as in summer, heavy underclothing keeps the skin continually moist when they are indoors, and they catch cold when they go out. It is better to make changes in the outer garments to suit the temperature of the air.

should watch it himself until he is satisfied as to the best arrangement.

A similar effect may be obtained by causing the patient to exhale into *rarefied air.* In this operation the pressure upon the surface of the body is greater than that within the respiratory passages, and, as a necessary consequence of this, the expulsion of air from the bronchial tubes is more easily accomplished. It is possible, of course, by this measure to put such a suction on the air contained in the lungs as to draw it all out, and produce a complete collapse—a return to the fœtal condition.

But, unfortunately, in exhaling into a chamber containing rarefied air, the air in the respiratory passages and that in the chamber are mixed, and the pressure in the bronchi and alveoli sinks until it is the same as that in the apparatus. In other words, it acts exactly like a cupping glass, and if not managed with the greatest skill the operation involves great danger of hæmorrhage.

Electrical stimulation of the contractile tissues is not feasible. The current can not be applied to a given portion of the nervous tissues exclusive of all the other portions. The result of my own efforts in this direction has been that when the current was strong enough to have an appreciable effect, it suspended respiration entirely, so that I was abundantly satisfied with the resumption of breathing when I removed the electrodes, which was done without standing on the order of their going.

The *chemical* means are numerous, and some of them are valuable. They may be divided into two classes: 1. Those which act immediately and are used to break up a paroxysm. 2. Those which are slower in manifesting their effect, and which are employed between the paroxysms, their use being continued over a long space of time, with the intent of overcoming the conditions which constitute the predisposition.

I must, at the beginning of the discussion of these measures, call attention to the fact, sometimes overlooked by practitioners in their anxiety to relieve the sufferings of one who is evidently in the most dreadful torture, that asthma is essentially a chronic disease—a chronic neurosis—and that it, like all diseases of its class, presents the danger of the formation of some habit of inebriety.

The very drugs which most quickly and certainly give relief—viz., *alcohol, chloral,* and *opium*—are the most deadly of narcotics, ruining the health, annihilating the moral force, and blasting the hopes of those who are unfortunate enough to fall under their terrible influence.

For *immediate relief* the following remedies are useful:

Morphine.—The hypodermic injection of morphine will seldom or never fail to give immediate relief, sometimes complete, sometimes partial, its extent depending on the amount administered, and also obviously on the susceptibility of the patient. Morphine, or any opium preparation, may be given by the stomach, and, if it is retained, it will be effectual, but not to the same degree as when it is injected hypodermically, because its absorption is gradual and it does not, at any given moment, exert the same intensity of action. If the absorption is very slow, the effects, while they are prolonged over a greater period of time, may never be intense enough to give any notable mitigation of the suffering. In asthma, as in cases of severe pain, the dose of morphine may safely be made rather larger than under ordinary circumstances.

As a rule, with adults, it is safe to begin with 10 minims of Magendie's solution (2 grains to 1 drachm of water). This should be given only when the attack is very severe, when the patient has not previously used the drug, so as to be in danger of becoming wedded to its use, or when it is of importance on account of danger from exhaustion or of the necessity of producing a strong moral effect, to make a speedy and certain impression upon the disease.

If the urgency is not great it is better to administer the opiate by the stomach, and by all means to keep the patient in ignorance of the nature of what he is taking, as thereby one retains control and secures the sufferer against the danger of incurring a disease far worse than asthma. For *internal* administration the best opiates are *codeine* (¼ to ½ a grain), *morphine bimeconate* (¼ of a grain), *vinum opii* (10 to 15 minims), *acetum opii* (5 to 10 minims), and Squibb's *liquor opii compositus* (10 to 15 minims).

The strength of the last-named preparation is about the same as that of laudanum in so far as it is an opiate; but the chloroform and ether which enter into its composition augment its power as a sedative of the nervous system. In fact, they not only add their own specific influence, but, by their quality of stimulants to the vascular and glandular tissues at the point of contact, they facilitate, or rather hasten, the absorption of the substances with which they are combined.

A still better formula, and one which I have used in many cases with few disappointments, is the following:

℞ Morphin. sulphat......... gr. j;
Spir. ammon. aromat...... f ʒ ij;
Spir. chloroformi......... f ʒ j;
Aquæ.................... ℥ v.
M.

A drachm of this mixture, containing ⅛ of a grain of morphine, 15 minims of aromatic spirit of ammonia, and 7½ minims of spirit of chloroform, will serve to relieve the dyspnœa in most cases, at least to the extent of allowing the patient to sleep, and to sleep quietly enough to get considerable rest. Such a formula may be used as a basis upon which to construct individual prescriptions to meet the requirements of particular cases. For instance, if the mucous secretion of the bronchial tubes is particularly adhesive, the addition of 10 or 15 grains of iodide of ammonium to the ounce may suffice for its correction. Or, in many cases, especially if we have cause to suspect the existence of an excessive susceptibility to iodine, 5-, or even 10-minim doses of *wine of*

antimony will be still better. Or, if it is known or suspected that the patient in hand is unduly nauseated by morphine, it may be replaced by *codeine*, which, while equally effectual in its proper dose, has not the same tendency to produce nausea. The *spirit of chloroform* also may sometimes be very advantageously replaced by *Hoffmann's anodyne* (*spiritus ætheris compositus*), the dose of which is much larger and the taste more disagreeable, but which has the advantage of being safe when given in large doses. Our original formula is, perhaps, improved by being put into the following shape:

℞ Codein. sulphat.......... gr. ij;
Vini antimonii .... ♏ xl;
Spir. ammon. aromat..... f ʒ j;
Spir. æther. comp........ f ʒ iv – vj;
Aq. menthæ pip.......ad f ℥ ij.
M.

The dilution of the ammonia and Hoffmann's anodyne has raised the dose to two teaspoonfuls instead of one. It is scarcely necessary to note that there must be further dilution at the time of administration.

Chloral hydrate.—This is next in importance to morphine as a means of prompt relief in violent attacks of asthma. We can not speak too frequently or too earnestly of the paramount necessity of extraordinary caution in the administration of these powerful narcotics in such diseases as asthma, which involve the cerebro-spinal system and are essentially chronic in their course. Every physician knows what the danger is, but it is, nevertheless, one of those dangers which come to be underestimated if one has been so fortunate as to have escaped.

Chloral hydrate is very speedy in its action, and seldom fails to arrest the asthmatic paroxysm. The dose for an adult whose heart is sound is 15 or 20 grains. For children the dose may be large in proportion to their ages. The existence of cardiac valvular disease is not to be considered prohibitory of the therapeutic use of chloral hydrate if the lesion is moderate, if the compensatory hypertrophy is sufficient to carry on the circulatory operations, and if the subject is not too greatly debilitated, particularly as regards the nervous system.

The greatest danger from the use of chloral hydrate is that, if continued for too long a time, it induces a peculiar cachectic state, characterized by anæmia, failure of digestion, chronic gastric or gastro-intestinal catarrh, a pasty, opaque skin, and an eruption of acne, pustular and tubercular, accompanied by ocular and palpebral conjunctivitis. There are besides great general debility, anorexia, anaphrodisia, and profound psychical depression. While the continuous use of chloral hydrate can be more easily and safely stopped than that of opium, chloral is more serious in its effects upon the organism, and should *never be used* except as a *temporary resource in very severe attacks;* and, if possible, the patient should be kept in ignorance of the nature of the remedy.*

The dose of chloral alone, as said above, is 20 grains.

It is often better to divide this into 5-grain doses, with 10 or 15 grains of bromide of potassium or of sodium, and give this every hour in solution with water and syrup of Tolu. If further means of disguising the taste are advisable, 10 or 20 drops of camphorated tincture of opium with each dose will be found very effectual.

Sulphuric ether is another extremely useful agent for the immediate control of an asthmatic paroxysm. It may be given in ½-drachm to drachm doses every half hour. It is usually given on sugar, and washed down quickly with water. Its volatilization by the heat of the body gives rise to a peculiar sensation of distention in the œsophagus, but that soon disappears.

Spirit of chloroform (spiritus chloroformi, U. S. Ph., Br. Ph.), or *chloric ether*, contains, according to the U. S. Pharmacopœia, 1 part of chloroform to 9 parts of alcohol, and is of twice the strength of the same compound in the British Pharmacopœia. It mixes very well with water, and the addition of a little Tolu or acacia sufficiently mollifies its irritating effects.

The irritation, however, subsides very quickly, leaving only an agreeable sensation of warmth diffused through the precordial and epigastric regions. Spirit of chloroform has an additional advantage in its power to prevent the nauseating effects of other drugs. For this reason it may at times be advantageously combined with morphine or any other opiate.

Hoffmann's anodyne, compound spirit of ether, is similar in its action to sulphuric ether and spirit of chloroform. The *ethereal oil* which it contains, in the proportion of 3 per cent., probably augments its calmative influence upon the nervous system. Unless it is combined with other remedies of the same class, the dose for an adult should be at least a drachm, and this should be repeated every hour until it becomes evident either that it is controlling the asthmatic paroxysm or that it is ineffectual. It should be diluted with from five to ten times its bulk of water.

The bromides of potassium, sodium, and *ammonium*, while not so rapid in their action as those already mentioned, are very useful as aids in subduing the asthmatic paroxysm. A large proportion of the cases of asthma are not so severe but that they may be impressed by these agents if given in full doses.

The bromides, like chloral, if given for too long a time, produce a cachectic condition most painful in its manifestations and deplorable in its results. But it is perfectly safe to give a few large doses which may so obtund the reflex excitability of the nervous system as to terminate the attack of asthma and to lessen the chance of its recurrence.

The bromides are especially valuable on ac-

* It would also be well not to combine it with celery to mitigate its unpleasant taste, as the writer knows of at least one proprietary nostrum which is flavoured with celery, and there might be a suggestion to try some such miserable thing.

count of the peculiarity that, when once their influence is established, the induced state may be kept up by the administration of comparatively small quantities, which may be continued almost indefinitely if there is no constitutional abhorrence of the drug. They should, however, be associated with some tonic, such as *strychnine*, *iron*, or *arsenic*, to assure the safety of the patient from the dystrophia which is so constant a result of their administration. A prescription that has been efficacious in quite a number of cases is about as follows. I must, however, remind the reader that the formulæ given in this article, as in all the others furnished by me, are proposed as bases for the construction of prescriptions to suit individual patients, for we do not expect a set recipe to suit all cases that have the same name applied to them. Physiology is not so exact a science as to admit of that kind of prescribing:

℞ Codein.................. gr. iv;
Sodii bromid............ ʒ ij;
Tinct. belladon......... f ʒ iv;
Tinct. nuc. vomic....... f ʒ iij;
Spir. æther. comp.... ad f ℥ iij.
M.
S.: A teaspoonful once in two hours.

If the dyspnœa is not very severe, it may not be necessary to use any more potent remedy than this. But, in order to inaugurate the remedial influence, if I may be permitted the expression, one should, at the outset, administer the doses very frequently.

Of any one of the bromides, 20 grains should be given at least every two hours, or, better still, 10 grains every hour, for six or eight hours, after which the frequency may be lessened one half, this *modus* continuing for twenty-four hours, after which time there may be a reduction of the dose to two thirds of its original size, and, if the symptoms warrant it, after forty-eight hours more there may be a still further reduction. I am convinced, however, that it is better to give smaller doses at more frequent intervals than larger ones with the intervention of longer periods. This plan commends itself for three reasons: In the first place, it has been testified by observers of great acuteness and clinical skill that this is really true. Secondly, by giving 10 grains every hour instead of 20 grains every two hours, its influence is kept at a degree of intensity which fluctuates less than under the other system. Thirdly, it may often be the case that a larger quantity of the drug may be used in a given time.

The *nauseating expectorants*—such as *ipecacuanha*, *squill*, and *lobelia*—are useful to some extent, but are too depressing and derange the digestion.

In case of emergency, other drugs not being at hand, should some member of this class appear to be indicated, it is better to employ the *tartrate of antimony and potassium*, in doses of from $\frac{1}{20}$ to $\frac{1}{10}$ of a grain, every two hours, and its efficacy will be greatly enhanced by the addition of a minute dose of calomel—*e. g.*, $\frac{1}{20}$ of a grain; a small dose of opium, say from to $\frac{1}{2}$ a grain; and 5 grains of sodium bicarbonate:

℞ Antim. et potass. tart.... gr. ij;
Hydrargyri chlor. mit.... gr. j;
Pulv. opii .... gr. ij–vj;
Sodii bicarbonatis........ ʒ jss.
M. et in chart. No. xx div.

One of these powders every two hours, or perhaps a little more frequently at the beginning, with an occasional saline if necessary, will often give more brilliant effects than some of the more recent and extensively advertised drugs.

Quebracho and *Grindelia robusta*, in their fluid extracts, have not attained the reputation which was expected at the time of their introduction.

The nitrate and hydrochloride of *pilocarpine*, by their powerful effect upon the vascular and glandular systems, are sometimes very valuable aids in the treatment of asthma. But the uncertainty of the action of jaborandi and the salts of its alkaloid, pilocarpine, makes it a very disappointing remedy.

Amyl nitrite sometimes gives temporary relief, which is very pleasing to the patient because of its rapidity. But it is uncertain, very evanescent in its action, and gives rise to such disagreeable sensations in the head that it attains to no popularity.

Nitroglycerin, in doses of from $\frac{1}{100}$ to $\frac{1}{50}$ of a grain, acts somewhat more steadily than the nitrite of amyl, but has the same faults. A solution is kept in the larger apothecaries' shops of 1 part of nitroglycerin in 99 parts of alcohol. It is known as *glonoin*. The dose is 1 or 2 drops. These drugs are usually thought to be somewhat dangerous, but I have not been able to confirm this idea. In fact, my friend, Dr. Edward R. Squibb, the great chemical manufacturer, has related to me an exciting incident in which a large bottle of amyl nitrite standing on his desk was upset and broken and its contents were instantly diffused in all directions. He experienced no ill effects whatever, nothing more than the usual flushing of the skin and some transient vertigo.

Iodide of ethyl, inhaled in quantities of from 5 to 10 drops, or even more, brings prompt relief to some, though the relief is not very enduring. It is, however, quite agreeable, and is often of great value in heading off an attack.

Inhalation of Oxygen.—This is a method mentioned only to condemn it. Oxygen has been thoroughly investigated and has been as thoroughly condemned or has found as few supporters as any agent ever recommended for the treatment of asthma.

As was stated at the beginning of this article, asthma is not characterized by a diminution of the respiratory area, excepting only in so far as the viscid mucus is concerned. The inspired air, in ordinary breathing, loses only 5 per cent. of its oxygen, and its detention in the bronchial tubes simply gives time for a greater diffusion to take place. The cyanosis is due to failure of blood to pass through the pulmonary capillaries with sufficient rapidity.

Compressed air, while favouring diffusion, distends the lungs. Besides, it requires too much apparatus, and may do harm unless the practitioner has very carefully studied the physical relations involved. Even so good a man as the late Dr. Geddings, writing in Pepper's *System*, speaks so loosely about Waldenburg's portable apparatus and the pneumatic cabinet, meaning apparently by the latter the cabinet of Dr. Williams, that one not familiar with these devices might be led into dangerous error by his remarks. Between the pressure change in Williams's instrument and that in the older cabinets there is a difference equal to 1 to 240.

Alkalies.—Whoever has acquired much experience in the treatment of asthma must have noticed that the paroxysms are associated almost invariably with a vitiated urinary secretion, characterized by great concentration, hyperacidity, and the presence of both urates and phosphates in exceptionally large quantities. Calcium oxalate is also found in many cases in such abundance that the crystals are encountered in large numbers in every microscopic field. Indeed, cases are met with which defy all our efforts until we take measures to relieve this hyperacidity, which, as we know, is not confined to the urine, but is a constitutional condition.

I have succeeded in relieving, and finally practically curing one of the worst cases of asthma that I have ever seen. But no progress whatever was made until I finally thought it worth while to try the alkaline treatment for rheumatism, and the paroxysm was almost gone by the time the urine had become continuously alkaline. The most feasible course is to provide the patient with some *blue* litmus paper and direct him to test it at every evacuation of the bladder. The bits of paper should be saved on a card, with the time of the test noted, so that the physician can trace the course of the reaction. As a rule, the urine should be rendered *continuously* alkaline, *i. e.*, the paper should be unchanged—blue at every urination. When this is accomplished it will be found in almost all cases that the dyspnœa is greatly reduced or even absent, while the bronchial mucus has become quite liquid and easily expelled by the cough.

Remedies for the Constitutional Predisposition.—1. Such systematic and properly selected and supervised *exercise* as can be expected to bring the vital organs to their proper degree of functional activity.

2. *Hydrotherapeutic Measures.*—It is not safe to bring these into the treatment unless the physician himself has considerable *practical* knowledge of the subject, and is satisfied that the directions will be properly executed.

Diet.—This is a very important means of influencing the constitutional condition of the patient. It is especially valuable in those not yet matured, say under thirty years old. After that period it is still capable of rendering great assistance, although its regulation as to quality, quantity, and ingestion is much more difficult than with the younger subjects. In the latter, success or failure in attaining results rests upon the respective moral qualities of parent and child, and upon the family discipline.

If the evidence makes the prospect of the carrying out of the details of our instructions doubtful, it is far better to make no attempt in that direction.

Climatic Influences.—These consist in the general changes in the organic functions which frequently result from change of residence; *local* modifications in the breathing apparatus by change of locality—*e. g.*, from coast to interior, from one altitude to another, from a cold to a warm or torrid region, etc., and the remarkable impressions which at times are made upon the nervous system by very decided changes in altitude, in atmospheric pressure, and in relative humidity; the character of the soil; the prevalence of certain winds; the diurnal, menstrual, and annual variations of temperature. As a rule, slight altitudes or sea-level positions, moderate variability of temperature, and a moderate but well-marked changeableness of the relative humidity are most favourable to nervous stability. The coast, also, is, with the average constitution, better than inland regions.

Habits of Life.—This is the most important item on this list, excepting *altitude*. Great altitudes are well known to have certain evil effects on the nervous system which I can not here explain. But the *mode of life*, social and domestic, the occupation of the individual, and the *habits*, as the word is generally understood, have a most important influence on the existence or non-existence of the physiological deviations which predispose to asthma.

This is as true of children as of adults, for children also have their bad habits, which are, at times, fully as injurious as those of their elders.

The two most important classes of bad habits are those which injure the respiratory tract and those which injure the nervous system. The physician who attends the case is the one best qualified to give the directions in all these matters, but they should be explicit and should be written down. It is a fact that directions which are written or printed are much more likely to be observed—ten times as much so as verbal instructions.

Medicinal Agents.—The medicinal agents which may be considered useful in combating the pathological states or conditions that predispose to asthma are not numerous if we limit our enumeration to those whose utility is established or, at least, acknowledged by so many as to give them a strong claim on clinicians for further trial.

Arsenic.—This is used in most of its official forms, some alleging a higher degree of efficiency for one, some for another. Probably the different compounds, both chemical and pharmaceutical, act differently upon different individuals. It is, again, not at all improbable that such other important modifications of environment as are produced by climate, mode of life, endemic diseases, etc., influence the action of these compounds, sometimes favourably toward one, and again toward another. Age, sex, and hereditary and acquired traits

may all have their influence. Even the skill which an individual physician acquires in the management of a particular drug is well known to have the effect of making him more successful with it than another practitioner, who, however, obtains equally good results from the use of some other. I shall not, therefore, attempt any analysis of reports, but name the drugs and, if necessary, state my own views in regard to their respective merits.

Liquor potassii arsenitis (Fowler's solution).—This seems to me to be the best of all the preparations of arsenic for the purpose of modifying, by prolonged use, the nutrition of the cerebro-spinal nervous system, the vaso-motor mechanism, and the splanchnic ganglia and plexuses. Fowler's solution has a great advantage in the fact that it has been well known and extensively used by the profession for so many years that its therapeutic effects are very thoroughly understood.

Arsenious acid is, therapeutically, about the equivalent of Fowler's solution, but is not so eligible for administration, particularly to children. It does not enter well into liquid preparations, and, as the dose for a child between five and ten years old is only from $\frac{1}{150}$ to $\frac{1}{100}$ of a grain, there is great uncertainty—unless we are sure of the apothecary's skill and conscientiousness—as to whether the drug is so equally distributed in powders or a pill mass as to be present in exactly the same quantity in each dose. Fowler's solution, on the other hand, having a potency equivalent to 1 per cent. of arsenious acid, is easily and safely dispensed in very minute doses. It is not, in the opinion of the writer, proper to prescribe this powerful solution *en masse*, and allow the patient or *anybody else* to drop it from a bottle. Bottles of Fowler's solution, tincture of aconite, etc., should never be in the hands of non-professional persons.

Bromide of arsenic.—This preparation has no demonstrated advantages over those already named; certainly it is not so useful as they are for our present purpose. It deliquesces, and, when dissolved in water, it decomposes with the formation of an oxide of arsenic (As_2O_3).

Chloride of arsenic.—This compound is chemically entirely analogous to the bromide. There are solutions of both of them, now official, which have the same strength (1 to 100) as that of Fowler's solution, but neither of which is constituted as its name implies, for both the chloride and the bromide are decomposed by water. They have no advantages.

Donovan's solution (the *liquor arsenici et hydrargyri iodidi*) is better by far than the two last named. It is more of a tonic than the others are, and more useful on account of the mercury, which acts well on the glandular apparatus and is an alterative of much value.

Potassium iodide.—This is a remedy which is, for the prompt relief which it gives, even to the extent of arresting prolonged paroxysms—*i. e.*, when they last twenty-four hours, and after a few days of preventing their recurrence, sometimes even forbidding the occurrence of a second attack after the one which suggests its exhibition—the most useful of all our therapeutic resources in asthma.

There are few physicians who would not, if given their choice of but one remedy for asthma, select *potassium iodide.*

The dose is 5 grains every two or three hours, increased slowly to 10 grains at the same intervals. Its combination with *potassium bromide* often increases its efficacy, but the bromide should not be used for more than two or three days—certainly not more than a week.

Sodium iodide is almost as good as *potassium iodide*, and may be combined with *sodium bromide* and with *sodium bicarbonate*, especially where acidity prevails.

Oil of pine needles, or *pine leaves* (*oleum pini foliorum*).—This preparation has not had a very extensive use hitherto, but my friend Dr. W. E. Griffiths reports personally the most gratifying results from its administration in doses of from 4 to 6 drops every three hours. He gives it on sugar. The relief—which comes after a few doses, and culminates, in a few days, in the disappearance of all signs of the disease—is probably caused by its action on the glandular apparatus of the respiratory tract and digestive system.

Terebene is quite similar in its action to the pine-needle oil. The dose is the same, or a trifle larger, and it is administered in the same way.

Tonics of all kinds are useful adjuncts in the treatment of the predisposition to asthma. The selection of the best one for use in a given case must be determined by the one who has the patient under his care. It is, of course, necessary, in order to get the best results, to change the tonic occasionally.

The remedies mentioned above apply to the treatment of those who are under the influence of predisposing causes.

Benjamin F. Westbrook.

ANTATROPHICS are medicines and articles of food that are supposed to be efficacious in promoting nutrition, such as cod-liver oil. They include some of the reconstituents, such as calcium phosphate and iron.

ANTEMETICS, or gastric sedatives, are those procedures and drugs by which *vomiting* is prevented or combated. The means employed to relieve vomiting are exceedingly numerous, and especially in those obstinate conditions, the vomiting of seasickness and the vomiting of pregnancy, the vast number of drugs and procedures which have been employed testifies to the uncertain action of antemetics as a class. Yet, while there is no drug or procedure which will in every case give relief, and therefore there is no specific for vomiting, there are many remedies which, used with judgment and discrimination, are highly efficacious as gastric sedatives.

Antemetics may be held to act either by a quieting action upon the vomiting centre, in which case they are said to act as *general antemetics*, this class including quiet, posture, opium, morphine, bromides, hydrocyanic acid, and possibly creosote; or by a sedative power

exerted upon the gastric mucosa, in which case they are referred to as *local antemetics* and include a vast number of drugs and foods, among them peptonized milk, alkalies, cocaine, iodine, calomel, cerium oxalate, carbolic acid, ipecac, and alcohol.

A consideration of the means used to check vomiting requires much more than a mere study of the antemetic drugs, and in rest, posture, food, and counter-irritants we find means of the greatest importance and usefulness.

Posture is indeed invaluable in checking vomiting, and often will alone suffice to accomplish that end, and, even if it is not efficient to that degree, yet as an adjuvant to other treatment it is of the greatest service. The patient should be placed in the horizontal posture and upon his back, and, that his comfort may be the greater, in all conditions associated with nausea and depression his clothing should be loose and light. The room should be kept cool and the air pure, for heated and impure air provokes nausea.

Quiet, too, should be insisted upon not only on the part of the patient, but in the room generally, and especially is this true in the vomiting of nervous origin and in neurotic subjects. A darkened room will act like quiet in diminishing nervous excitement, and so decreasing the tendency to emesis.

External applications are often of great value in preventing and checking vomiting, and of these none is so reliable and effectual as a *mustard plaster*. This, if applied to the epigastrium and kept there as long as practicable, will often succeed in allaying nausea and vomiting without the employment of other means. The strength of the mustard plaster must depend upon the activity and violence of the gastric symptoms; one made in the proportion of 1 part of mustard to 4 parts of flour is usually regarded as the extreme of strength, while those of less strength (even 1 to 10) are often effective in less active disturbance, and have the advantage of more prolonged action, since they may longer be retained in position. The *ice-bag* may be applied to check vomiting, either to the nape of the neck, to the lumbar region, or to the epigastrium. Though it has its advocates, it is but slightly effective, save in the vomiting associated with hysteria, and in no way generally to be compared with the mustard paste in effectiveness.

Emetics are often decidedly indicated in nausea and vomiting, and, though themselves producing vomiting, it is true, yet they act as antemetics by removing from the stomach those undigested substances which are frequently the cause of the disturbance, and thus directly promote gastric quiet. Thus, in the nausea and vomiting which often follow the eating of indigestible food the administration of *zinc sulphate*, *copper sulphate*, or *ipecac*, or, if haste is an object, the subcutaneous administration of *apomorphine*, will act most efficiently to relieve. Of similar action and even greater effectiveness is *lavage*.

Though in the vomiting of *acute gastric inflammation* (where from the brevity of the attack starvation is scarcely possible) it is wiser to withhold all food and to restrict the amount of drink so far as is possible, limiting it to small quantities of cracked ice or extremely cold water, especially carbonated water, taken in small amount; yet there are many conditions in which food must be given notwithstanding the vomiting, and in some of the modifications of *milk* and in the use of milk as a vehicle for antemetic drugs we have valuable means of treating vomiting. In all cases where milk is thus given it is, however, to be administered at first in small doses, usually of about 1 drachm, and only with the improvement in the patient's condition is the amount to be increased.

Peptonized milk may be given in such conditions, and is often well borne, but it must not be forgotten that, if the peptonizing process has been carried to completeness, or even to a considerable extent, a bitter taste is acquired by the milk which in itself may be sufficient to cause vomiting. Peptonized foods other than milk, too, may be given, such as gruels, soups, etc., but they are neither so nutritious nor so effective as milk, and are only indicated where variety is an object, and therefore not in vomiting of limited duration. Milk, indeed, may be given in its natural state if the attack is not severe and if the milk is exceedingly cold. Taken in small quantities, it will often be well borne. A mixture of milk and Vichy water is yet better borne, for, in addition to the dilution of the milk, there is the antemetic action of the carbonic acid contained in the effervescent water.

Milk may be given containing *lime water* in quantity varying from one eighth the amount of milk to an equal quantity, and this is often better borne than any other food, the effect being due not only to the dilution of the milk, but to the sedative properties of the alkali.

One of the most effective ways of giving milk in cases of this kind is to add to each glass of milk 5 grains of *cerium oxalate* and 10 grains of *sodium bicarbonate*. This, given in small doses, as above described, is one of the most trustworthy and effective measures in such cases, the cerium oxalate and the bicarbonate of sodium exerting marked power as antemetics.

The fermented milks—*koumiss*, *matzoon*, and *kephir*—are excellent antemetic foods in certain cases, though by no means always well borne. They are usually not liked by patients at first, but with a little use they are generally tolerated, and often exceedingly well liked, the preference of some patients being for koumiss, and that of others for matzoon. Kephir, though an excellent preparation, is comparatively seldom used. The antemetic properties of these fermented milks lie in the alcohol they contain as well as in the carbonic acid, and as controllers of vomiting they may be compared to champagne, over which they have the additional advantage of possessing the food value of milk.

In considering the antemetic drugs, no satisfactory order or classification is possible, and in properties as well as effectiveness they manifest the greatest variations.

Carbonic-acid gas, as administered in car-

bonated waters, is in some cases effective the water being given in small amounts and as cold as possible.

Alcohol may be efficient, and, given in the form of *iced champagne*, is doubly so from the presence of the carbonic-acid gas. The champagne should, however, invariably be "dry"; sweet wines but increase the vomiting. Thus employed, champagne is specially indicated in the vomiting of *seasickness* and acute febrile disease.

Chloroform, in doses of from 1 to 2 drops in water, will at times relieve, and in *seasickness* it is thought to have a special value. This is, however, to be doubted, like the efficacy of almost all remedies recommended for this obstinate and defiant affection.

Ether, too, may be employed in small doses, and acts presumably by a stimulant effect upon the gastric mucous membrane when it is in an atonic condition. It is at times serviceable, but generally not to be depended on.

Opium may be given to relieve nausea and vomiting, and exerts this power by a quieting influence upon the vomiting centre, a fact which renders it possible to administer it by the rectum as well as by the mouth. Indeed, in this respect opium has a marked advantage over the majority of antemetics, since when it is thus administered there is no necessity of disturbing a stomach already too much disturbed. Opium as such, though antemetic at first, often seems to be productive subsequently of nausea, and even vomiting, conditions which are less frequently seen if morphine is the form of opiate used, and particularly if it is given hypodermically, but which even then are by no means of very uncommon occurrence.

The *bromides* are at times exceedingly useful in relieving the *vomiting due to cerebral disease* or that resulting from a reflex cause, as well as from neurotic disturbances in general. For *seasickness*, too, they have been much employed as prophylactics, considerable doses of a bromide being given for about two days preceding the day of sailing, under the impression that this would diminish the nervous irritability upon which seasickness was supposed to depend. Though by many the bromides have been thought effective when so used, they are utterly untrustworthy, and quite as likely to cause digestive disturbance as to prevent it. The recently introduced *strontium bromide* is thought to be more effective than the other bromides as an antemetic, and certainly does appear to act well in *vomiting of nervous origin*, though its use has not yet been sufficient to enable us to consider its value fully determined.

Chloral hydrate has been used in cases similar to those in which the bromides are used, but generally its effectiveness is not great.

As *ipecac* in large doses is emetic, so in small doses is it antemetic; for, in vomiting due to nervous disturbance, and particularly in that obstinate condition the *vomiting of pregnancy*, the administration of drop doses of wine of ipecac will at times be exceedingly efficient.

Arsenic is often serviceable in vomiting, especially when due to gastric irritation and gastric ulcer. It is preferably given in the form of Fowler's solution, in doses of $\frac{1}{2}$ a minim or 1 minim, in water.

Tincture of iodine, in minute doses, may be tried, and will at times work well. In the *vomiting of pregnancy*, where drug after drug is tried and discarded, it will sometimes act when all others have failed.

Dilute hydrocyanic acid is a gastric sedative of considerable value, its antemetic power being exerted especially in *vomiting of nervous origin*.

Calomel will often relieve gastric irritability, if given in small and repeated doses, and particularly when the irritability is associated with intestinal disturbance. In all such cases, unless purgation is specially contra-indicated, calomel should be tried, and it will generally be of service.

Bismuth subnitrate is efficient in some cases, especially where gastric irritation or inflammation is present.

The *alkalies* are generally more valuable in vomiting associated with hyperacidity, decomposition, and fermentation, and in such cases *sodium bicarbonate* or *lime water* may be given in milk, or *magnesia* may be employed.

Cerium oxalate is generally very efficient in gastric disturbance and ranks high among antemetics. The usual method of administration has already been described.

Sulphonal may be used to check vomiting, and seems at times of some value. The usual method of administration is by the addition of from 3 to 5 grains of sulphonal to a glass of milk and the giving of the milk as is done when it is associated with cerium oxalate.

Pepsin and *ingluvin* are at times given as antemetics, but they are of comparatively little value.

Cocaine is very effective in vomiting, acting locally upon the gastric mucosa to diminish its excitability. Its dose for such purpose is usually $\frac{1}{10}$ of a grain. Though this dose is minute, the peculiar susceptibility of many persons to cocaine must not be forgotten.

Carbolic acid is often valuable as a gastric sedative, acting partly to diminish the irritability of the gastric nerves and partly as an antiseptic, and, though *creosote* has been thought to have some effect in quieting the vomiting centre, or, in other words, to act as a general antemetic, it is probable that its efficiency is due to an action similar to that of carbolic acid.

In some few cases where other drugs have failed *atropine* or *belladonna* will be efficient, but they are scarcely to be used save as substitutes, other drugs being generally more reliable.

In the *vomiting of chronic gastric disease* astringents are sometimes of service, especially small doses of *alum* or of *nitrate of silver*.

Nux vomica, in small doses, too, will frequently be of benefit in the *vomiting associated with gastric atony*.

Seasickness has been attacked by so great a variety of drugs and with such poor success that it seems hardly necessary to speak of drugs so used, but among them *amyl nitrite* and *nitroglycerin* have in some cases been thought beneficial.

[In the *Lancet* for April 21, 1894, Dr. M. Charteris, of the University of Glasgow, gives extracts from reports made to him by thirty ship surgeons as to the utility of "*chlorobrom*" as a remedy for *seasickness.* He summarizes as follows: "1. In *long* sea voyages no prophylactic benefit can be secured by the use of chlorobrom unless for two nights before embarkation the passenger pays due attention to the stomach and bowels by taking a cholagogue pill. Further, in the case of a person who dreads a voyage a dose of the solution should be taken. 2. The diet on board ship should be 'spare and dry.' Soup, pastry, and sweets should be especially avoided, and no full meal should be indulged in. A hypnotic dose (one tablespoonful and a half for a male, and one tablespoonful for a female) should be taken for three nights. 3. In *short* voyages, when the steamer leaves, perhaps, at 10 P. M., the passenger should immediately retire to rest, and take one of the doses mentioned. 4. In a *shorter* passage across the Channel a teaspoonful should be taken before going on board. 5. By following these directions immunity from seasickness is obtained in the great majority of cases, but if they be not followed it is to be remembered that chlorobrom has no effect in arresting an outburst of vomiting. If it is given in a teaspoonful dose every ten minutes until a tablespoonful and a half or a tablespoonful have been taken, it will almost invariably check retching and depression."]

Aconite, in small doses of the tincture, has been employed as a gastric sedative in *vomiting due to excitability of the gastric nerves.* Thus used, it often appears to act well, a result explained by its usual benumbing effect upon the endings of sensory nerves when directly applied.

Resorcin has been used as a gastric sedative in conditions associated with fermentation, but, though theoretically it may here act as an antiseptic, it certainly does not usually have much effect as an antemetic.

The simple *bitters* will often check vomiting, especially that due to the prolonged abuse of alcohol, most typically seen in the "*morning vomiting*" *of drunkards.* For this, *calumba*, *gentian*, and *serpentaria* are often employed. In such cases, however, a more decided effect is produced by their combination with an aromatic, which by stimulating the atonic mucosa will generally relieve the vomiting. The aromatics generally so employed are *cinnamon*, *capsicum*, and *ginger.*

Salicylic acid and its salts are at times serviceable, but, though they act thus by virtue of their antiseptic powers, and hence particularly in conditions of gastric fermentation, it must not be forgotten that in their prolonged use or in large doses the salicylates, as well as the acid itself, are decidedly irritating to the stomach, and thus at times *productive* of vomiting.

That vomiting is frequently associated with intestinal disturbance is well known, and in that occurring with simple constipation there is nothing more effective than a promptly acting *saline cathartic*, preferably, on account of its effervescence, *Seidlitz powder.* If the intestinal disturbance producing this vomiting is due to sluggish hepatic action, however, a more decided effect will follow the use of *podophyllin.*

Oxygen water has, in many cases of gastric disturbance, appeared to act as an excellent antemetic.

Oil of cajuput and *oil of cloves*, too, are at times effective, but they are by no means to be regarded as constant in their action.

In some cases the *mineral acids* have seemed effective, and *hydrochloric acid* has been particularly recommended in the treatment of the *nausea and vomiting due to alcoholic overindulgence.*

Though it is usual to administer the drugs of which I have spoken by the mouth, in spite of the gastric disturbance, and though the vast majority of them must be so used, since their action is solely a local one upon the stomach, yet there are those whose action is general, or at least follows absorption, and, if we prefer, they may be introduced otherwise than by the mouth. Thus, opium and the bromides may be administered by the rectum and morphine hypodermically. Indeed, the hypodermic administration of morphine is apparently the best means of combating vomiting as such of which we are possessed, and, though it may subsequently be followed by some gastric disturbance, this is only occasionally seen, so that, if vomiting must be stopped promptly and no contra-indication to its use exists, morphine thus employed is our most trustworthy drug for the purpose; indeed, by some it is considered almost a specific.

In the *vomiting of uræmia* the treatment of uræmia alone will prove effective, and perhaps hot-air baths are the most striking in their results.

In spite of all treatment, it not infrequently happens that vomiting will persist, and under these circumstances we are often not justified in giving anything by the mouth. It is therefore frequently necessary to abstain from the introduction of food, drink, or drug into the stomach, but, leaving that organ entirely unemployed and, so far as may be, at rest, to support and nourish and treat the patient by the employment of nutrient and medicinal enemata.—HENRY A. GRIFFIN.

ANTENNARIA.—See GNAPHALIUM.

ANTEPILEPTICS.—Drugs capable of curing epilepsy are not known. Certain remedial measures that are not drugs seem in some instances to accomplish a cure; for the most part they are operative procedures designed to rid the organism of a source of persistent irritation, such as a narrow or adherent prepuce. Medicines that are considered palliative, diminishing the frequency and intensity of the paroxysms, are numerous. The bromides are the chief of this class of remedies, and the reader is referred to the article on them, and for the others to the articles on the individual remedies, as referred to in the Index of Diseases, etc., under the word EPILEPSY.

ANTEROTICS.—See ANTAPHRODISIACS.

ANTHELMINTHICS.—This class of remedies may be conveniently divided into the *vermicides*, which have a toxic influence upon intestinal worms, and the *vermifuges*, which simply expel them living.

The *tæniæ*, on account of their firm attachment to the walls of the intestine and the large amount of mucus which envelops the attached portion, are by far the most difficult variety of intestinal parasites to dislodge.

There is scarcely any pathological condition of such relatively slight importance in which failure to relieve so often results, and for which such an endless variety of remedies has been proposed. That any one of several tæniacides or tæniafuges will either destroy a tænia or expel it in a living state is an unquestioned fact; and whenever failure results the blame is to be laid, not upon the particular remedy selected, but upon the neglect to observe proper precautions in its administration. Whatever is used, it is essential that it should come in *free contact* with the animal, especially the attached portion, or "head," as it is conventionally but incorrectly termed.

To render this possible, a careful *preparatory treatment* is of the greatest importance, and in the large majority of cases absolutely necessary. The object of this preparation is to remove as far as possible the accumulated mucus and fæcal matters so as to allow the remedy to come in contact with the worm. To prove effectual, the preparatory treatment must begin at least a week before it is expected to use the medicine, and in some cases in which the digestion is decidedly perturbed a fortnight is none too long for preparation.

The first point to be looked after is the digestion, which if disordered must be rendered as nearly normal as possible by the use of *bitter tonics*, *mineral acids*, *pepsin*, etc. *Absinthium* is probably the best tonic, as it seems to possess some anthelminthic properties. Every morning a free movement of the bowels must be obtained by the use of cathartics. The salines and the alkaline cathartic mineral waters are the most suitable.

For three days prior to the use of the anthelminthic catharsis should be quite free and the diet restricted to such articles as leave little residue to be disposed of by the intestines. *Bread* and *milk* are the popular foods for this time, and are the most appropriate. They need not be used to the exclusion of all other articles, if they are not agreeable to the individual, but *soups*, *rice*, and similar foods may be substituted.

By the laity *salted meats* and *fish* are highly esteemed in this connection, and they are often useful, if readily digested, not on account of their being obnoxious to the tænia, but because of the specific action of the salt they contain in rendering the intestinal mucus less tenacious. This property is possessed by all chlorides, and consequently the administration of from 10 to 15 grains of *ammonium chloride* three times a day constitutes a useful adjunct to the preparatory treatment. If, however, a mineral water containing chlorides, such as the *Friedrichshall*, has been used for its cathartic effect, the ammonium chloride may be omitted. During the last twenty-four hours no food except milk or clear soup is admissible, and these only in the smallest quantities consistent with the comfort of the individual. Although it is desirable to have the intestines as empty as possible, care must be taken not to lower the person's strength so as to render the retention of the anthelminthic doubtful.

The morning is the best time for the dose to be taken, and on an empty stomach; and, unless catharsis follows in the course of three or four hours after its administration, a cathartic is to be given. This should be as active as the strength or age of the person will warrant, as strong peristaltic action of the intestines assists in the dislodgment of the parasite, and may by itself have that effect. *Gamboge* is a very good cathartic, especially for children.

As nausea almost always follows the administration of tæniacides, and in fact is one of the most serious obstacles in the way of their effectiveness, it must be combated by the *recumbent posture*, *hot water* to the abdomen, small doses of *potassium bromide*, etc. Sometimes, if the patient is a heavy sleeper, it is a good plan to rouse him at a very early hour, and after giving the medicine allow him to sleep for several hours.

As soon as any inclination to have a movement of the bowels is shown the person should sit on a vessel containing water and remain there, if possible, until the entire animal is expelled. In this way traction upon it is avoided, and it is usually possible to obtain the entire worm. Sitting in a bath tub full of water is advised by some, but this seems hardly necessary, is decidedly unpleasant to the patient, and is calculated to prejudice the mind against a second attempt if it should become necessary. The excreta must be examined carefully to ascertain the absence or presence of the "head." This is most easily done by collecting them on a sieve and allowing a gentle current of water to pass through. If the "head" should not be found, it is more than probable that the treatment has failed, although in a certain number of cases the detachment of the worm close to the "head" has been followed by its death.

Whether a second attempt should follow immediately after the failure of one is a question which must be decided in each case. It is safe to say, however, that a delay of at least a fortnight should follow unless the individual concerned is very strong and not unduly weakened by the treatment. In most cases it is best to delay until the fully developed segments are again visible in the fæces. Often the period of convalescence from an attack of gastro-enteritis, to which the victims of tapeworm are very liable, is an excellent opportunity to administer an anthelminthic without any preparatory treatment, and in some cases where several attempts have failed by reason of the inability of the person to retain the medicine it furnishes the only chance of success.

The plan here advised for what is usually regarded as being of no great importance may seem unnecessarily elaborate, but, as under such conditions success is nearly certain, it is un-

doubtedly best to adopt it. Failure to relieve a person of a tapeworm is sure to bring reproach upon the medical attendant, and, moreover, a second attempt is much more apt to fail than an initial one, especially in children, in whom the knowledge that the preparatory treatment is to be followed by a nauseous dose is almost sure to interfere with its retention when it is given.

Occasionally infants who are given raw meat become affected with tapeworm, and in such cases treatment must be deferred until the child is at least a year old.

When, for that or any other reason, it seems best to postpone treatment for a while, it is a good plan to give small doses of *oil of turpentine* from time to time. This will cause the detachment of a large number of the segments, and no more will escape until they have reached the proper stage of development, which usually will be several days. In this way one of the most unpleasant features of helminthiasis will be prevented.

As might be expected, in a condition which through neglect or carelessness is so often treated unsuccessfully, the remedies which have been suggested are almost without number, but only a few of them are of the slightest value. *Aspidium, pomegranate root* or its active principle *pelletierine*, and the *crushed seeds* of the *common pumpkin* are the ones most commonly used.

There is little occasion to choose from them. *Pelletierine*, on account of the relatively small dose needed, is perhaps the best, but, unfortunately, its high price prevents its use except by those in good circumstances. *Pumpkin seeds* seem to be the least apt to excite nausea, and on that account may be the most desirable in some cases. *Oil of turpentine* is probably the surest tæniacide we have, but its use is unsafe on account of the excessive dose required. *Powdered anthracite coal* (see ANTHRACITE) has been used with success in some instances.

Kousso, mucuna, areca nut and its alkaloid *arecine*, and powdered *tin* have been recommended, but present no advantages over the remedies mentioned previously, and are rarely used. *Papain* and *papoid*, on account of their solvent effect upon albuminoid bodies, have been suggested with the idea of digesting the worm, as it were, but their use has not proved very satisfactory.

For *ascarides vermiculares*, or threadworms, the treatment is usually local, as they rarely extend beyond the ileo-cæcal valve. Enemata containing *common salt, carbolic acid, quassia*, or *aloes* are most commonly used, and are entirely satisfactory. There is no particular advantage in one over another, and whichever is most convenient may be employed. No fixed rule as to the strength of these enemata can be laid down. The only thing to be avoided is irritation of the rectum by too highly concentrated solutions. In fact, complete relief is often obtained by simple cold-water enemata. Immediately before the use of the enema the perineal region, also in the female the external genitals, must be sponged with a one-per-cent. aqueous solution of carbolic acid, to prevent the lodgment of the worms after they have been removed from the rectum. No preparatory treatment beyond the thorough emptying of the rectum by a cathartic is needed.

If there is reason to suspect the presence of the worms high up in the colon, in the small intestines, or in the stomach, a dose of *santonin* or *kamala* and *calomel* should be given, and as soon as it has acted the enema should follow.

When the *Ascaris lumbricoides*, or round worm, exists, it is wise to restrict the diet for forty-eight hours to bread and milk and clear soups, and to evacuate the intestines thoroughly by saline cathartics before the use of an anthelminthic. *Santonin* is the one usually given, being preferable to *mucuna, fluid extract of spigetia, oil of chenopodium*, and *kamala*. These latter are effectual enough, but are more bulky and less easily administered. The santonin is best given at night, together with calomel in an ordinary cathartic dose, and followed in the morning by a saline.

RUSSELL H. NEVINS.

ANTHEMIS.—See CHAMOMILE.

ANTHIDROTICS are substances that diminish the secretion of sweat. The morbid and excessive sweating which calls for their use is sometimes associated as a symptom with some special disease, when interference may or may not be desirable, and sometimes, in the absence of any obvious assignable cause, it is what is termed "*idiopathic*." It may also be either general or confined to a limited area. Though the pathology of *hyperidrosis* is often vague, certain facts more or less well established furnish indications for the use of special remedies. For example, it is known that when the influence of the sympathetic is withdrawn from any region—as, for instance, when the supplying nerve is divided—sweating of the part supplied results. Dilatation of the blood-vessels and hyperæmia of the sweat glands have this effect. Certain actions exerted upon the nervous centres of secretion in the spinal cord, whether through high temperature, a toxic agent, or excessive venosity of the blood, will cause sweating. Anthidrotics may often be rationally employed to meet such indications, though as frequently perhaps they are used, or have been discovered at least, empirically. Some act generally or upon the nerve centres, others locally or at the periphery—*i. e.*, directly upon the perspiratory apparatus. Where nerve debility exists vaso-motor stimulants are indicated, such as *nux vomica, strychnine, ergot*, and *zinc oxide*. The beneficial effect of *quinine* in the *night sweats of phthisis* has been attributed to its action in reducing the high temperature. But an indication for quite another class of remedies in phthisical sweats has been found, through partly theoretical reasoning, in a condition of excessive venosity of the blood, suggesting agents that stimulate the nerve centre of respiration. It is argued by Brunton that in cases of pulmonary phthisis the respiratory centre, through excessive stimulation attended with the prolonged coughing of the daytime, becomes comparatively insensitive at night during sleep,

permitting of an accumulation of unaërated venous blood which in a normal state would be dispelled by increased respiration and which finally acts as an irritant upon the secretory centres of the cord with the result of causing an excessive secretion of sweat. On this supposition, therefore, the chief indication is for agents that act as stimulants to the respiratory centre—such as *picrotoxin*, *pilocarpus* (which, though ordinarily a sudorific, here acts in the contrary way through its stimulation of the respiratory centre rather than the secretory), *ipecacuanha* or *Dover's powder* (to which what was said of pilocarpus also applies), *strychnine* or *nux vomica*, *muscarine*, and *belladonna*. *Belladonna*, as well as its alkaloids, *atropine* and *duboisine*, however, has another action which is exerted peripherally in paralyzing or obtunding the ends of the secretory nerves, and this is perhaps its most important action as an anthidrotic. It makes it a remedy which is effective not only when used internally, but also as a topical agent in the form of a liniment or lotion, particularly in cases of *partial* or *regional sweating*. *Agaricus* and *agaricin* are said to act in the same way as belladonna and atropine. The employment of *mineral acids* in hyperidrosis has been explained on the general principle that acids tend to diminish the acid secretions, while alkalies lessen the secretions that are alkaline. Of the value of these acids there is no question, whatever be the amount of truth in the principle as stated. A similar explanation may apply to local applications of *vinegar*, which have a good effect often in profuse sweating. A remedy very strongly advocated by Crocker, more particularly in cases of *partial hyperidrosis*, is *sulphur*. A level teaspoonful of precipitated sulphur is given in milk twice a day as the usual dose, or where it purges it is combined with a little cinnamon and powdered chalk. No explanation is given of its action. It is known that sulphur given internally is eliminated in the form of sulphuretted hydrogen through the skin sufficiently, often, to blacken any silver worn upon the person. It might therefore more easily account for an effect upon offensive sweat (bromidrosis) than upon the profuse secretion. In many of the cases of partial hyperidrosis, especially affecting the feet and axillæ, the sweating is offensive, constituting *bromidrosis*, and the treatment must be directed to the latter condition as well as the former. *Boric acid* in powder or lotion, sometimes combined with *salicylic acid* or with *permanganate of potassium* (1 per cent. in lotion), is a good remedy for this. The boric acid may be dusted over the articles of clothing worn next the skin, or the latter (the stockings, for example) may be prepared before they are worn by soaking them in a saturated solution of the boric acid and then allowing them to dry. Another very efficacious remedy for bromidrosis of the feet is *chromic acid* in a 5- to 10-per-cent. solution applied once in from two to four weeks. Hebra used *diachylon ointment*, which was changed twice every day for two weeks, and required the patient to be kept quiet or in bed. These topical remedies all have a modifying action upon the epidermis and upon the sweat follicles as well. It would be well to use such internal remedies as seem appropriate at the same time, more particularly such as stimulate the sympathetic, and perhaps the sulphur treatment of Crocker.—E. B. Bronson.

ANTHRACITE.—Teaspoonful doses of anthracite coal, free from slate or pyrites, reduced to granules of about the size of No. 9 bird shot, have sometimes been used to expel *tapeworms*.

It is supposed to act mechanically, dislodging the worm in its passage along the alimentary canal. It should not be given to the very young or to the weak, as it excites a considerable amount of intestinal irritation.

The same preparatory treatment advised under the article Anthelminthics must be adopted. Unless there is intolerance of other more approved remedies or nothing else is at hand, the use of coal is hardly to be commended.—Russell H. Nevins.

ANTHRAROBIN, $C_{14}H_{10}O_3$, is an odourless, yellowish-white, granular powder, a reduction product of alizarin, of flavopurpurin, and of anthrapurpurin. In 1888 it was introduced into dermatological practice by Liebermann, of Berlin, as an advantageous substitute for chrysarobin. It has been found to be much less irritating than that substance. It is practically insoluble in water and in dilute acids, but dissolves readily in dilute alkaline solutions; in such solutions, however, it is prone to oxidation, whereby it is converted back into alizarin, the colour changing from a golden brown to green, blue, and finally violet. Anthrarobin is soluble also in alcohol, in glycerin, and in a solution of borax. Behrend has found it very useful in *psoriasis*, *ringworm*, and *erythrasma*, in the form of an alcoholic or glycerin solution or that of an ointment, in the proportion of from 10 to 20 parts of the drug to 80 of the excipient. Its action is somewhat slower than that of chrysarobin, but it has the great advantages of being non-poisonous and of not irritating the skin to which it is applied.

ANTHYDROPICS are remedies that tend to promote the absorption of *dropsical effusions*. They are evacuants, including the cathartics, diuretics, and diaphoretics.

ANTHYDROPIN.—See under Blatta.

ANTHYSTERICS are remedies that are supposed to mitigate or cut short the paroxysms of *hysteria*. So far as drugs are concerned, the chief anthysterics are castoreum, asafœtida, valerian, camphor, and sumbul. Systematic writers class anthysterics as a division of the antispasmodics.

ANTIARIS.—The *Antiaris toxicaria* is an artocarpaceous tree, belonging to the group *Ulmaceæ*, that grows in Java and the neighbouring islands, and that has been known to the English-speaking world as the *upas tree*. The name of the tree is taken from the Javanese, *antsjar*, and Leschenault de Latour first described it under the present botanical name.

The tree exhales a toxic principle that affects some individuals, and perhaps birds and

animals, and that has originated the story that birds flying over the tree or animals approaching it closely fall dead in consequence of this miasm.

All parts of the tree contain a poisonous principle, but a juice is collected by incising the bark, that is known as the *upas antiar*, a Malayan term signifying *vegetable poison.* From 100 parts of this juice there may be obtained about 38 parts of a brownish-red, waxy, resinous substance that has an acrid bitter taste. This resin is used as an arrow-poison by the natives of the islands. From this resin Pelletier and Caventou isolated a toxic principle *antiarin*, and Bettink isolated two other substances, *œpain* and *toxicarine.*

Antiarin is a neutral substance that crystallizes in brilliant scales, is soluble in water and in alcohol, but is very slightly soluble in ether or benzene. Boiling antiarin in dilute acids converts it into *antiarrhetin* and sugar. Antiarrhetin occurs in feathery crystals that are soluble in alcohol, ether, benzene, or petroleum ether.

One sixth of a grain of upas antiar, introduced within the veins of an animal, produces a very rapid elevation of arterial pressure that persists for some time and disappears slowly as the poison is eliminated. Maurice Doyon's experiments show that the upas acts on the vaso-motor centres of the medulla oblongata, and that death is due to arrest of the heart in consequence of the direct action of the upas on the cardiac muscle, though in some instances death is caused by bulbar action.

Toxic doses of upas or of antiarin produce convulsions, vomiting, voiding of urine and fæces, irregular respiration, cardiac irregularity, and speedy death.

Administered medicinally, it has caused violent vomiting and tenesmus. It has no therapeutic use at present.—S. T. Armstrong.

ANTIBACTERID is a German patented antiseptic said to be made by melting together 350 parts of borax and 200 of glucose, with the addition of a little water, and adding 125 parts of boric acid.

ANTIBAKTERIKON is a German proprietary preparation said to contain ozone and to have been devised as a prophylactic of all infectious diseases. It is probably of little if any value.

ANTIBLENNORRHAGICS.—With all the great good that has come and is yet to come to modern medicine because of modern science, nomenclature will probably remain as it is to-day, irrelevant and untrustworthy. The term *blennorrhagia* is from the Greek βλέννα, mucus, and ῥήγνυσθαι, to gush forth—a gushing forth of mucus. It was introduced to correct the errors of suggestion conveyed by the term *gonorrhœa*, from γόνος, semen, and ῥεῖν, to flow, meaning a flow of semen. *Baptorrhœa*, from βάπτειν, to infect, and ῥεῖν, to flow, while etymologically more correct, has not been at all generally accepted by medical philologists. By an antiblennorrhagic is meant literally a remedy to check a gushing forth of mucus. The term is now, however, understood to mean a remedy administered *internally* for the cure of *specific urethritis* and its sequelæ.

It is with blennorrhagia as with all infectious diseases for which as yet no definite specific, no positive antitoxine, has been discovered—a vast array of vaunted so-called specifics offer. The striking contrast between the broad lines laid down for the internal medication of a clap and the closely drawn "mercury-and-potash" lines of syphilitic therapeutics need but to be called to mind to make manifest this fact.

Yet there is probably none other of the infectious diseases in which the matter of internal therapeusis is, at least theoretically, of more worth proportionately to the prevalence of the disease than blennorrhagia, from the fact that this disease is an infection of what is in many respects the most important of all the emunctory tracts of the body. As Milton suggestively puts it, "gonorrhœa has been successfully treated with purgatives and diuretics, corroboratives, astringents, and laxatives, demulcents and alexipharmacs, mercury and iodine, acids and alkalies, anæsthetics, tonics, specifics, and treatment on general principles."

The fact that the renal apparatus is exceedingly amenable to passing influences—dietetic, medicinal, and thermal—should never be lost sight of in the management of any case of blennorrhagia, whether acute or chronic.

For want of a better grouping, antiblennorrhagics may be classified as specifics, vasomotors, and diluents or diuretics.

In 1885, while in New York, I heard Dr. George E. Brewer read his now well-known paper on the antiseptic treatment of gonorrhœa. This paper was the outcome of the labours of Dr. Holbrook Curtis, Dr. W. S. Halsted, Dr. Brewer, and others, based upon the discovery of the gonococcus of Neisser, and by this discovery looking to the short-cut cure of gonorrhœa by heroic urethral antisepsis. During the discussion that followed, Dr. E. C. Wendt, an enthusiastic disciple of Neisser's, was asked by Dr. R. W. Taylor what should be done with the old stand-bys, copaiba, cubebs, santal oil, etc. "What excuse have we," said he, "for their further internal exhibition if all hope of cure depends on the destruction of the gonococcus by germicides locally applied, or how can we explain the good that these remedies have done in the past?" The answer made was that, while these oils possessed apparently no definite germicidal properties in their medicinal state, they developed during their passage through the circulation and in their excretion by the renal organs germicidal powers that within the closest lines of antiseptic theory warranted their use.

Be this as it may, the fact stands, backed by clinical evidence leading up to biblical times, that a group of internal remedial agents, mainly essential oils and almost without exception indigestible and nauseous, are held by the profession and the public alike to exert a specific curative influence over blennorrhagia.

They come and go in popularity, these oils, with now and then a new fellow added to the family, heralded always by some enthusiastic

advocate, usually to be condemned subsequently by others, less biassed, as utterly inefficacious, or be by common consent dropped from further use.

Without any such rational explanation as we possess for the exhibition of mercury in syphilis, they are generally prescribed on purely empirical grounds, and so with necessarily questionable results.

The making of a group of vaso-motor antiblennorrhagics is justified by the peculiar character of the renal blood-supply. The arteries of the kidneys, it will be remembered, come off from the abdominal aorta in both size and direction exceedingly favourable to an exceptionally high degree of blood-pressure. The *vasa recta* perpetuate this power, while the *glomeruli*, arterial clusters in the tufts of Malpighi, possess an endowment of muscularity, and therefore of vaso-motor possibilities, hardly inferior to that belonging to the erectile tissues. Indeed, the wide ebb and flow of their vaso-motor action that take place under purely physiological influences are in their scope probably without parallel in any other part of the body. It is a simple matter, if we are imbued with this conception of renal vaso-motor endowment, to conceive of the grounds for the administration, under varying conditions, of such remedies as digitalis, squill, and ergot. Indeed, it is possible that that vast array of diuretics, so called, to which belong pareira brava, buchu, uva ursi, corn-silk, triticum repens, etc., act upon the glomeruli rather than upon the metabolic protoplasm of the kidneys. Certain it is that these agents do, without reference to the amount of fluids ingested, excite a decided increase in the amount of urinary secretion.

Just where the line may be drawn between a *specific* and a *diuretic* antiblennorrhagic has not yet been and may never be determined, and so we administer from our ample group of agents alkalies in the acute stage, and, as this yields to the stage of decline, the so-called specifics, with santal oil, cubebs, and copaiba ranking as they are here mentioned, and a field made up of matico, kava-kava, terebene, gurjun, boric acid, salol, methylene blue, and the like, all praised and all condemned in turn as we ring the changes on them and record the cures or failures, often the latter, as our cases come and go. Usually, where failure is the case, we have recourse to diuretics or diluents with more scientific justification than we had when administering specifics.

So long as specifics are being exhibited diluents are contra-indicated, for it is manifestly desirable that the urine should be then as concentrated as possible in order to increase the percentage and proportionately the power of the drug being excreted. Now, however, when weeks, or even months, have elapsed, when local treatment backed by Lafayette mixture and the essential oils has failed of a cure, when the membranous and the prostatic portions of the urethra, the base of the bladder, the seminal vesicles, and possibly the ureters and the pelves of the kidneys have in turn been invaded by gonococci, streptococci, and staphylococci, not to overlook epididymitis and the barrenness it threatens; when these conditions, one or more, have developed, demonstrating the futility of ordinary injection treatment, comes the time when the prime duty of the therapeutist is to fit to his case such antiblennorrhagics as shall in turn cleanse and disinfect those hidden tracts that even the most persistent bladder-washing must necessarily fail to reach. At this period it is that, while treating with local agents the parts accessible by such agencies, antiblennorrhagics may be most widely and most wisely used.

There is one diluent *par excellence*, one whose antiblennorrhagic powers as a flushing, cleansing agent outrival all others, and it is in its turn, for manifest reasons, underestimated and misjudged. That agent is *water*. Men of cultured habits generally recognise the benefits of the bath, and almost as a rule, proportionately to their rank in the social scale, seek and enjoy the varied means at their disposal for bathing purposes, yet how rarely do we find, among such even, be they either sick or well, any conception of the good that comes of water-drinking for any other purpose than that of quenching thirst! When we do, it is almost without exception because of their faith, not in the water, but in some rare medicinal virtue that is supposed to lurk in the output of some famous healing spring. Thither they flock during the season to quaff of the wonderful flow, to return in the majority of instances, be the disease what it may, after a brief sojourn, much improved in health by the first systematic internal body-washing they have ever had. Hardly a spring of this character is advertised but what trumpets its virtues as an antiblennorrhagic. And what tables of composition they print and circulate! Not one of these waters but what, always with a minimum of *organic* matter, is certified by some famous chemist to have a dozen or more chemicals of marvellous efficacy in its composition, solids and gases, and all so exquisitely dissolved and blended in the occult laboratories of Nature as to make the bubbling fluid a God-given boon to sick humanity. And yet what is it, after all? Water, water always, and water, as a rule, of which, because of the absence of the ordinary heavily mineral, "hard" characteristics of common drinking water, may be drank even in enormous quantities without exciting gastric disturbance. It is true, of course, that the Epsom, Carlsbad, Saratoga, and other waters of that class have, added to their aquosity, several of the saline laxatives, and also that the numberless sulphur springs of this country owe part of their reputation justly to the presence of some saline laxatives in addition to sulphur in various forms, recommending them for *its* usefulness both internally and externally.

Allowing this, however, it still remains true of those light, delicious, tasteless waters whose name is legion, and for each one of which some rare special medicinal property is vehemently alleged, that an exquisite, delicious *purity* is their talisman with which they unlock those nooks and crannies of the body where germs

abide and toxines lurk, to cleanse and purify. They glide so softly down the throat and touch so lightly on stomach and bowels that, with the deepest potations, one can scarce drink to satiety. It is such waters that are usually and justly most vaunted as antiblennorrhagics, and where no obstacle, such as acute inflammation, stricture, or catheter life, exists to interfere with free and frequent urination, their usefulness in many cases is immensurable. In, however, the three conditions just named—acute inflammation, close stricture, and catheter life—the harm ensuing from their use is almost equally great.

But human nature craves humbuggery in, at all events, a mild form, and so it is hardly probable that any famous watering place will arise and develop popularity in many years to come that bases its only claims to merit on the healthfulness of its location, the invigorating character of its atmosphere, and the *absolute purity of its water.*

Wherever the first two of these ideals exist the third may be had in the rainfall, and with slight expense and simple precautions one may stock his storeroom with a palatable diluent antiblennorrhagic equal in efficacy to any of that great class of light, soft waters that under different names are lauded and sold for their specific virtues.

Distilled water, which may be properly classed with these just mentioned, has long had a reputation for unpalatableness. While its very purity, by contrast with ordinary drinking water, probably explains this, yet, where it is ordered *as a medicine*, to be *drank*—say half a gallon to a gallon daily, irrespective of thirst—it will be found to agree with the stomach and to flush the renal emunctories, *tuto, cito et jucunde.* A pinch of dry salt taken into the mouth before and after the drinking will quite effectually obviate all distaste.

To summarize. Viewed from a strictly microbian standpoint, we have no positive evidence of the existence of any distinctly specific blennorrhagic; yet, according to valuable clinical evidence, we are possessed of a group of drugs, not necessarily diuretic in their action, which, when administered internally in blennorrhagia, are excreted by the kidneys, always with beneficial and frequently with positively curative results. Of this class are santal oil, copaiba, cubebs, pichi, kava-kava, gurjun oil, matico, salol, boric acid, sodium benzoate, methylene blue, oil of gaultheria, oil of eucalyptus, oil of turpentine, erigeron, and diuretin. Again, all remedial agents that are ordinarily classed as vaso-motor tonics are at times useful as antiblennorrhagics for obvious reasons, the chief of which is the extreme development of vaso-motor powers in the renal apparatus, already referred to. In this group are digitalis, ergot, squill, and cantharides, while turpentine and its derivatives, with perhaps many others of the first group, may be said to belong to both classes, being both vaso-motor stimulants and antiseptics.

The tendency, when abused, of members of both groups to set up objectionable and often severe renal irritation, should not be overlooked. This, of course, calls for a diminution in dose, or even complete discontinuance.

The great family of vegetable diuretics, such as buchu, uva ursi, pareira brava, pipsissewa, stigmata maidis, triticum repens, and a host of others too numerous to mention, and the ordinary saline diuretics, including spirit of nitrous ether, probably act chiefly as vaso-motor stimulants, and as such may frequently be administered along with copious draughts of water, for the purpose of mechanical cleansing. Finally, the exhibition of antiblennorhagics should, as a rule, be: In the earliest stages, diluents with alkalies; in the second, specifics without diluents; and in the third, with its many complications—and we should be influenced largely by the character of these complications in individual cases—diluents followed by specifics. We should alternate and ring the changes upon the various agents at command, with local treatment, and the use of iron, quinine, strychnine, and proper hygiene is not to be overlooked in the battle. Digitalis is of most use when the kidneys are involved, while ergot seems to exert a positive influence on that analogue of the uterus, the prostatic urethra.

Edward R. Palmer.

ANTICNESMATICS, commonly called *antipruritics*, are remedies to alleviate *itching.* In the treatment of this troublesome and often tormenting symptom, its cause should be sought for at the outset, and it will usually be found to depend on a cutaneous lesion, which may or may not be due to the presence of animal parasites. If these are discovered they may be dealt with in the manner described in the article on Antiparasitics. In some instances itching is unconnected with any apparent skin disease, but may be an expression of a functional nervous derangement, of disorder of the digestive, urinary, or genital tract, or, as in the case of pruritus vulvæ, of diabetes mellitus. In all but the most trivial cases, mitigation of the itching should be one of the definite aims of treatment, along with the cure or alleviation of the disease on which it depends.

General itching (*pruritus universalis*)—and by this is meant, not itching of the entire surface, but the frequent and often almost constant itching of first one part and then another, with or without a special predilection for any particular part—is generally due to hepatic disease or to the cutaneous degenerative changes incident to senility. It is in this form that *cannabis* and *gelsemium* have been found specially useful (see the articles on those drugs).

Local itching depends on some morbid state of the affected part itself or on disease so situated as to be in close nervous connection with the itching area. In all cases a careful examination of the part should be made, in order to ascertain the cause of the itching; it will not do to assume, for example, that pruritus vulvæ occurring in a woman known to have diabetes is necessarily due to that disease, for diabetes is no guarantee against pediculi or ascarides. When the cause of the itching has been ascertained the prime object of treatment is to abate it; if, like phtheiriasis, it is one that can be

done away with speedily, there will be no occasion to resort to anticnesmatics, for the itching will vanish with the destruction of the insects that gave rise to it. If, however, the fundamental morbid condition is incurable, palliation of the itching will have to be sought for in the employment of special remedies, either taken internally or applied locally (see the INDEX OF DISEASES, etc.).

ANTICOLICS are remedies used for the alleviation of colic. They include external applications, carminatives, and anodynes.

ANTICONVULSIVES. — See ANTISPASMODICS.

ANTIDEPERDITORIES. — This term has been applied to such agents as coca, coffee, and arsenic, on the supposition that their action in sustaining the bodily strength and preventing or mitigating fatigue was due to their lessening the elimination of nitrogenous material from the system.

ANTIDIPHTHERINE. — A substance isolated by Professor Edwin Klebs from cultures of diphtheria bacilli in fluid media, and proposed by him for use in the treatment of *diphtheria*. Starting from the principle that the growth of pathogenic bacteria in culture media gradually diminished after a certain time, and then ceased with the death of the micro-organisms, he concluded that the latter produced secretions that were inimical to their own existence. These substances are closely related to the albuminoid group, and Klebs divided them into sozalbumins and toxalbumins.

The cultures of diphtheria bacilli employed in the preparation of antidiphtherine, which is a sozalbumin, are sterilized by means of orthocresol, the destruction of all bacillary life being determined by test-cultures. The remedy, as prepared, contains 0·2 per cent. of orthocresol and some glycerin. Sufficient information is not furnished regarding the method of separating the sozalbumin from the toxalbumin in the cultures, if such separation is made, and it may be said that this preparation is to be classed with proprietary remedies. It is supplied in two degrees of concentration, one of which is said to represent the second, the other the fourth concentration of the original culture fluid.

It has been said to kill the diphtheria bacilli with which it comes in contact not only in a test-tube, but in the human body. This statement has been contradicted by V. G. Grigorieff, of Moscow, who asserts that it does not in the least inhibit the development of those bacteria even after twenty-four hours' continuous contact. Its use is said to be unattended with danger; and, while it is alleged that it reduces high temperature in from twenty-four to forty-eight hours after local applications, the writer has not observed any marked antipyretic effect follow its use.

At first the remedy was applied to the diseased spots on the fauces, palate, and pharynx by means of a pledget of cotton twisted about a probe, or the entire pharyngeal region was brushed with the solution. The soaked cotton was held in contact with the patches as long as the patient could comfortably tolerate it, and the applications were made two or three times a day and the practice continued as long as large pieces of membrane were present. When only small shreds remained one painting a day sufficed. For these applications, numbering in all from four to seven, from 5 to 10 c. c. of the remedy were required. Klebs advised that the preparation should be applied with great gentleness as well as thoroughness, especially in very young children, an injunction that is necessary when it is recalled that injudicious excitement or irritation of the child enhances the danger of heart failure. If the temperature does not fall after applying the remedy the inventor advises that untouched patches be sought for, and, in the event of none being discerned, that applications be made to the nose and naso-pharynx or to the larynx and trachea.

In an article published in the *Medical Record* for December 15, 1894, Professor Klebs has reported that this remedy had been employed in fifty-one cases, in which there was a mortality of 13·7 per cent., all forms of diphtheria being included.

In the same article Klebs states that antidiphtherine may be used subcutaneously or by the rectum as well as applied topically, "especially in severe and older cases" (meaning, it is to be presumed, severe cases occurring in persons past infancy). He advises the injection of $\frac{1}{10}$ c. c. every hour until ten injections have been given, after which the injection is repeated two or three times a day, "or still increased, if necessary." Pending adequate clinical observation with regard to the possibility of any danger resulting from the treatment, he advises that the action of the heart be watched carefully while it is being carried out.

The results obtained by the employment of the remedy at the Willard Parker Hospital, New York, were unsatisfactory, and furthermore, its hypodermic use was manifestly harmful.

[Antidiphtherine must not be confounded with the diphtheria *antitoxines* of Behring, Roux, and others, or with a German secret preparation said to be a yellow powder smelling like chlorine and containing as its chief ingredients iron, chloride, and potassium chlorate.]—SAMUEL T. ARMSTRONG.

ANTIDIPHTHERITICS are medicines used topically in the treatment of diphtheria, such as iodine, potassium chlorate, and iron chloride.

ANTIDIPHTHERITIC SERUM.—See under ANTITOXINES.

ANTIDOTES are agents which affect a poison either physically or chemically, or both, so as to remove it from the body or alter its character before absorption, and thereby *prevent* its toxic action upon the organism. They do their work in the alimentary canal or in the respiratory passages, and are applicable to vegetable as well as mineral poisons, but are

not available against poisons administered hypodermically.

Thus in *poisoning by digitalis* the *antidote* is tannic acid, which forms, with the active principles of the drug, compounds (tannates) which are comparatively insoluble and therefore comparatively innocuous. But as these tannates are not wholly inert, an *antidotal measure* must be employed in addition—viz.: evacuation of the stomach, which is obtained by the administration of an emetic or by the use of the stomach pump.

Antagonists, on the other hand, are agents which *counteract* the effects of poisons after absorption by their opposite physiological action in the blood and tissues upon the vital functions of the body. They are applicable almost wholly to vegetable poisons, and are especially available against such administered hypodermically. (See ANTAGONISTS.)

In the Treatment of Poisoning, whether by mineral or vegetable substances, the first indication is to administer the appropriate chemical antidote, so as to render the poison harmless or comparatively so. Next, the stomach should be emptied and washed out, lest the newly formed compound be absorbed after a time, and to remove any of the poison which may have escaped the action of the antidote. Next, the antagonist should be administered, in order to counteract the effects of such portion of the poison as may have been absorbed. Lastly, the appropriate antagonistic measures should be employed to sustain the action of any organic function which may show signs of failure. In most cases of alkaloidal poisoning absorption has proceeded so far before assistance is obtained that antidotes are of no value, and reliance can only be placed upon the physiological antagonist and such supporting measures as will tend to maintain vitality until the poison can be eliminated by the natural channels.

Antidotes include sundry chemical substances as well as measures of various kinds, and may be divided into two classes: (*a*) the *mechanical*, or antidotal measures; (*b*) the *chemical*, or true antidotes. The so-called physiological, or dynamic, antidotes are the antagonists, which are treated of under the latter title.

The Mechanical Antidotes include such agents and measures as may remove poisons as such from the system, or may mechanically prevent their absorption. Emetics, cathartics, washes, injections, ligatures, poultices, and the use of the stomach pump, tourniquets, etc., belong to this class.

Emetics, when employed, should be used without delay. They are often rendered needless by vomiting induced by the poison itself, or by the free use of diluent drinks; and are contra-indicated when there is severe corrosion of the alimentary canal or when abdominal inflammation exists. Sodium chloride, as an emetic, is contra-indicated in *poisoning by tartar emetic* or *corrosive sublimate;* and so also are oils and fats, or substances containing them, in *poisoning by phosphorus, cantharis*, or *copper salts.* The best emetics are zinc sulphate (from 15 to 30 grains in water), copper sulphate (from 1 to 5 grains in water), ipecac (in powder), emetine (from $\frac{1}{12}$ to $\frac{1}{3}$ of a grain), and apomorphine (from $\frac{1}{16}$ to $\frac{1}{6}$ of a grain hypodermically); but the following may be used: Tartar emetic ($1\frac{1}{2}$ grain, acting slowly and as a depressant), turpeth mineral, cadmium sulphate, common salt (2 teaspoonfuls to a pint of water), mustard (2 teaspoonfuls to a cup of warm water), olive oil, soapsuds, snuff, melted fats also tickling the fauces with a feather or the finger.

Cathartics are generally employed after the use of a chemical antidote, to remove the compounds formed thereby from the intestinal canal. The best are castor oil, croton oil, senna, and magnesium sulphate (Epsom salt). Castor oil protects the mucous membrane and obstructs absorption, but is contra-indicated in *poisoning by phosphorus, copper salts,* or *cantharis*, the absorption of which is aided by oils and fats. Croton oil is rapid and powerful in the dose of from 1 to 5 minims, on a bread pill. Magnesium sulphate, in the dose of from 1 to 4 oz., well diluted, is of special service in *chronic lead poisoning* and to remove antidotal compounds from the intestines. Senna, gamboge, and other drastics are the best cathartics in narcotic poisoning.

The Stomach Pump and **Stomach Siphon** are efficient, and do not weaken the patient as emetics do, but are not always available, and can not be used when there is corrosion of the stomach or œsophagus, for fear of perforation. They are useless when the poison is in solid form and in large pieces (such as meat, sausage, fish, cheese, etc.).

Chemical, or **True, Antidotes** act on the poisons themselves, not on their effects, by uniting chemically with the poisons, and so converting soluble and absorbable substances into compounds which are more or less insoluble and non-absorbable, or harmless though soluble. Their use is, however, restricted to cases where the nature of the poison is known, and they should be in themselves harmless, easily obtained, and of rapid action. Their products should be removed from the gastro-intestinal canal as soon as possible. They include organic as well as inorganic substances; the *organic* are albumen, milk, charcoal, soap, oils, turpentine, tannin, etc.. and the *inorganic* are acids, ammonia, carbonates, hydrates, sulphates, sodium chloride, iodine, sodium hyposulphite, sulphuretted hydrogen, iron preparations, potassium permanganate, etc.

Albumen is an ideal antidote, being harmless and easily procured, and forming compounds which are more or less insoluble with most of the metallic salts, corrosive alkalies, and mineral acids, as also with iodine, bromine, chlorine, creosote, aniline, and alcoholic solutions of most of the alkaloids. It is especially suitable against inorganic poisons, and was recommended by Orfila for invariable use, even on mere suspicion of poisoning. It should be well diluted, the whites of four eggs to a quart of lukewarm water. Its compounds (albuminates) with mercury and copper are,

however, soluble in an excess of itself; those formed by it with salts of lead, copper, and zinc are easily dissolved in lactic, acetic, and other organic acids and in free alkalies; those with silver salts are partially soluble in an excess of common salt; and that with corrosive sublimate, easily in mineral and organic acids, in a solution of a chloride or of sodium phosphate, and in a large excess of albumen itself.

Milk is a good substitute for albumen, its action being nearly the same in range and due to its casein, albumin, and free alkali. It is particularly valuable against *poisoning with metallic salts*, *corrosive acids* and *alkalies* (especially *ammonia*), and the *alkaline earths*, but it is contra-indicated when fatty antidotes are to be avoided, by reason of its richness in fat.

Gelatin is of special value against *poisoning with iodine, bromine*, and the *alums*, but requires too much time for its preparation, as it should be broken up, soaked in water for half an hour, and reduced to the consistence of honey.

Gluten is of value against *corrosive sublimate*, but less so than albumen, and is not easily obtained.

Tannin (tannic acid) precipitates the *alkaloids* and their salts, forming therewith compounds (tannates) which, though comparatively insoluble, are not entirely inactive, and should be removed at once from the alimentary canal by emetics and drastic purgatives. It forms compounds which are more or less insoluble with many metallic salts, but is inferior, in this respect to albumen, except in the case of *tartar emetic*, which albumen does not affect, but tannin renders harmless. It is usually given in doses of from 15 to 45 grains, in a 2-per-cent. solution, every quarter of an hour; and if it is combined with about 10 per cent. of its weight of iodine its antidotal effect on vegetable poisons is greatly increased. If it is not itself obtainable, decoctions or infusions of substances containing it may be substituted, such as tea, coffee, nutgalls, kino, rhatany, catechu, and the barks of oak, willow, and cinchona.

Oils and **fats** are very efficient antidotes against the *corrosive acids* and *alkalies, metallic oxides, metallic salts*, and *carbolic acid*, but are contra-indicated in poisoning by *phosphorus* or *cantharis*, the absorption of which they promote. With the caustic alkalies they unite to form soaps, liberating glycerin; they are inferior to albumen against metallic salts; and, as their action is slow, they are less efficient than acids against alkalies. Those used are olive, cotton-seed, linseed, and almond oils, also melted butter and lard.

Starch, in paste (1 part to 15 parts of water), is the antidote against *iodine* and *bromine*, with which it forms compounds which are almost harmless. It has some value against *corrosive acids, corrosive sublimate*, and *copper* and *zinc sulphates*, but not so much as albumen, which is preferred for these forms of poisoning, as well as for that with iodine, since it has a greater affinity for these poisons than starch has.

Soap, in the form of "suds," is an efficient antidote against *acids* and *metallic salts*, especially *corrosive sublimate, potassium bichromate*, and the *salts of tin* and *zinc*. It is inferior to albumen against these, but is preferred to caustic alkalies against acids, as of itself it has no corrosive action.

Gum arabic, in the form of mucilage, is chiefly used as a protective against *corrosive poisons*, and has been recommended in copious draughts against *poisoning with the bismuth salts.*

Charcoal has some antidotal value against many *alkaloids*, the *metallic salts*, and *phosphorus*, slowing their toxic action and postponing their effects, probably by a protective action upon the gastric walls. It has the valuable property of absorbing gases, but enters into no fixed compound with any mineral or vegetable poison. Fresh animal charcoal is the best, though wood charcoal is efficient, but in lesser degree.

Oil of turpentine, after long exposure to the air, and therefore containing much oxygen, is the antidote against *phosphorus*, and should be administered immediately after the ingestion of that poison, alone or in hot water, and in the quantity of 100 times the amount of the phosphorus supposed to be present.

Organic acids, such as acetic (vinegar), citric (lemon juice), and tartaric, are employed against the *alkalies* and *alkaline carbonates.*

Inorganic acids.—Diluted sulphuric acid, in water, is used against the soluble *salts of barium* and *lead*, with which it forms insoluble sulphates; also as a prophylactic against the colic of lead poisoning.

Ammonia, diluted, used by inhalation, is an efficient antidote against the vapours of *corrosive acids* and *nitrobenzol*, also *chlorine*, *bromine*, and *hydrocyanic acid.*

Magnesium hydrate and carbonate are the most efficient antidotes against *acids* and the *acid salts*, and even against *oxalic acid* and the *acid oxalates*, in the absence of the calcium antidotes. They are also valuable in *poisoning by arsenic, phosphorus, mercury, corrosive sublimate*, and other *metallic salts*, forming with arsenic compounds which are almost insoluble, and with metallic salts in solution precipitating the corresponding oxides or basic salts.

Magnesia is a compound of the hydrate and carbonate with water, or a basic magnesium carbonate. When heated at a low temperature it becomes calcined, losing CO_2 and H_2O; and then mixed with 25 times its weight of warm water it becomes gelatinized, in which condition it is best for antidotal purposes, in doses of from 1½ to 2 oz., at short intervals for a few doses, then at longer intervals. An excess does no harm, but rather benefits the patient by its cathartic action.

Carbonates and bicarbonates of sodium and potassium are employed against most of the poisonous metallic salts, especially those of *zinc*, which they immediately decompose, forming insoluble basic compounds; also against *iodine, bromine*, and *potassium bichromate*, forming the neutral chromate with the lat-

ter and harmless salts with the former. They are useful in dilute solution against *acids*, but are less easily tolerated than magnesium sulphate. They are contra-indicated in *poisoning by oxalic acid*, with which they form dangerous compounds.

Calcium hydrate and carbonate, in the form of lime water, chalk, eggshells, or powdered oyster shells, are used against *acids*, both mineral and organic, and especially against *oxalic acid* and the *acid oxalates*, which they neutralise and convert into the insoluble calcium oxalate.

Sulphates of magnesium and sodium (Epsom and Glauber's salts), the soluble sulphates, are particularly efficient against *carbolic acid* and the *salts of barium* and *lead.*

Sodium chloride (common salt), in dilute solution, is the best antidote against the *silver salts*, converting them into the insoluble chloride of silver. It may be given with albumen, which is also a very efficient antidote in this form of poisoning.

Potassium ferrocyanide, given in doses of from 30 to 60 grains in water, is of special value against the *copper salts*, but albumen is equally efficient and more easily obtained.

Potassium permanganate is the best antidote against all *organic poisons*, if used promptly, before absorption has taken place, as it rapidly destroys them by oxidation. It has been used successfully against *morphine* and *strychnine salts* in the stomach, and locally for *snake-poison.* Dr. Moor, of New York, is reported to have experimentally swallowed 3 grains of morphine sulphate in the presence of several physicians, and then to have taken a solution of 4 grains of the permanganate in 4 oz. of water, without any morphine effects having been noticed on him afterwards. As morphine, after making the round of the circulation, constantly returns in part to the stomach until it is eliminated, the permanganate solution taken from time to time may have a continuous antidotal action on such portion of the morphine as has been absorbed.

Iron.—The **hydrated sesquioxide** is the best antidote to *arsenic* in solution or in a soluble form, as it combines with it to form a ferrous arsenate, and also protects the gastro-intestinal mucous membrane against the local action of the poison. In the proportion of 10 parts to one of arsenic the union is very complete, but its union with the salts of arsenic is limited even when it is in great excess, though much more effectual if there is added to it a small amount of ammonia or other caustic alkali, or if the basic ferric acetate is mixed with it. For the preparation of the official arsenic antidote see *Ferri oxidum hydratum cum magnesia*, under the title Iron.

Dialyzed iron, saccharated iron (*ferrum oxydatum saccharatum*), and the basic ferric acetate have all been used with more or less success in arsenic poisoning.

Copper carbonate, in the dose of from 3 to 6 grains, with sugar and water, preceded and followed by an emetic, is recommended in *phosphorus poisoning*, being supposed to coat the particles of phosphorus first with a layer of copper phosphide and then with one of copper itself, thus preventing their solution in the fluids of the stomach.

Sodium hyposulphite, in doses of 15 grains, in very dilute solution and frequently repeated, is a valuable antidote against *bleaching powder* (*calcium hypochlorite*), *Labarraque's solution* (*sodium hypochlorite*), and *Javelle water* (*potassium hypochlorite*), which it reduces to chlorides, itself undergoing oxidation to the sulphate.

Chlorine, in the form of chlorine water, Labarraque's solution, or Javelle water (see below), is employed externally as an antidotal wash for *snake-bites* and other *poisoned wounds;* also, well diluted, internally against *alkaloids* and other *vegetable* and *animal poisons;* and as a spray for antidotal inhalation against *coal gas* (*carbonic oxide*), *ammonia*, *phosphoretted* and *sulphuretted hydrogen*, and *hydrocyanic acid.*

Iodine, in very dilute solution, is used as an antidote against *alkaloids* and their salts, also other *vegetable poisons*, and *snake-venom.* All its compounds are more or less soluble and toxic, and must therefore be removed from the system as soon as possible. *Bouchardat's antidote for vegetable poisons* consists of 3 grains of iodine, 30 grains of potassium iodide, and 11 oz. of distilled water. The dose, which is from 1½ to 3 oz., should be repeated frequently.

Ammonium carbonate, in the dose of 5 grains, administered hypodermically in the vicinity of wounds caused by *poisoned arrows*, was repeatedly used by Dr. Parke, the surgeon of Stanley's last expedition in Africa, with entire success in saving life when it was employed immediately after the injury. Persons so wounded, if they were at too great a distance to receive this treatment, invariably died within a short time.

List of Poisons and their Antidotes (not including *antagonists*, for which see that title. For more detailed information, see the different subtitles in this article, also the headings of individual poisons throughout the book).

Acid, Carbolic.—Epsom or Glauber's salt (magnesium or sodium sulphate), saccharated lime, albumen, oils.

Acid, Hydrocyanic.—Persalts and protosalts of iron (if there is time to do anything), with magnesia; ammonia, inhaled diluted, or chlorine water in the form of spray, for the vapours.

Acid, Oxalic.—Calcium hydrate or carbonate, in the form of lime water, chalk, whiting, or wall plaster, in water; magnesia. Avoid potassium and sodium carbonates and bicarbonates.

Acids, Mineral.—Alkalies, such as sodium bicarbonate, magnesia, chalk, whiting, or wall plaster, in water; albumen, flour, milk, soap, starch, olive oil.

Acids, Vegetable.—Alkalies, such as chalk, whiting, plaster, etc., in water.

Alkalies.—Acids, diluted, such as vinegar, lemon juice, etc.; albumen, milk, gelatin, oils.

Alkaloids.—Tannin, albumen, potassium permanganate, iodine, charcoal; emetics and cathartics afterwards.

Ammonia.—Acids (diluted), albumen, milk,

oils; vapour of vinegar or chlorine-water spray, inhaled, for the vapour.

Amyl Nitrite.—Artificial respiration.

Anæsthetics.—Artificial respiration.

Aniline.—Albumen, milk.

Antimony.—Lavage of the stomach with water first, then with solution of tannin; milk, albumen.

Arsenic.—Ferric oxide (freshly prepared by precipitating a solution of ferric chloride with sodium carbonate or ammonia, or in the form of the official *ferri oxidum hydratum cum magnesia*), dialyzed iron, saccharated iron oxide, basic ferric acetate, magnesia.

Barium Salts.—Epsom or Glauber's salts (magnesium or sodium sulphate), diluted sulphuric acid.

Bismuth Salts.—Gum arabic in the form of mucilage.

Bleaching Powder.—Sodium hyposulphite.

Bromine.—Albumen, starch, gelatin, sodium and potassium carbonates and bicarbonates; for the vapour, ammonia vapour, inhaled, or steam inhalations.

Cantharis.—Linseed tea, gruel, barley water, as demulcents; water in large quantity to flush the kidneys. Avoid oils, fats, and milk.

Carbonic-acid Gas.—Artificial respiration.

Chlorine.—Albumen; ammonia or steam inhalations for poisoning by the vapour.

Coal Gas.—Chlorine water in the form of spray, artificial respiration.

Colchicum.—Tannic or gallic acid, then emetics.

Conium.—Tannic or gallic acid, then emetics.

Copper Salts.—Albumen, soap, potassium ferrocyanide. (See *Metallic Salts*, below.)

Corrosive Sublimate.—Lime water and milk, albumen, gluten, magnesia; emetics or the stomach pump afterwards. (See *Metallic Salts*, below.)

Creosote.—(See *Acid, Carbolic*, above.)

Croton Oil.—Lavage of the stomach, demulcents, emetics.

Curare.—Ligation above the wound, if there is any, which should be incised freely and sucked powerfully; artificial respiration.

Cyanides.—(See *Acid, Hydrocyanic*, above.)

Digitalis.—Tannic acid, followed by emetics.

Ergot.—Tannic acid, followed by emetics.

Gelsemium.—Artificial respiration.

Iodine.—Starch, flour, gelatin, sodium and potassium carbonates and bicarbonates.

Javelle Water.—Sodium hyposulphite.

Labarraque's Solution.—Sodium hyposulphite.

Lead Salts.—Sulphuric acid diluted freely with water, emetics. (See *Metallic Salts*, below.)

Metallic Salts.—Albumen, milk, magnesia, starch, soap, oils and other demulcents, sodium and potassium carbonates and bicarbonates, lavage of the stomach, emetics and cathartics.

Morphine.—Potassium permanganate. (See *Alkaloids.*)

Mushrooms.—Castor oil.

Nitrobenzol.—Ammonia, diluted, by inhalation; artificial respiration.

Opium.—(See *Alkaloids* and *Morphine*, above.)

Phosphorus.—Old, acid oil of turpentine, copper carbonate with sugar and water, copper sulphate as an emetic and as a chemical antidote, charcoal, magnesia. Avoid oils, fats, and milk.

Physostigma.—Artificial respiration. (See *Alkaloids.*)

Potassium Bichromate.—Sodium and potassium carbonates and bicarbonates, soap. (See *Metallic Salts*, above.)

Savine.—Epsom salt, demulcents.

Silver Salts.—Common salt in solution with albumen. (See *Metallic Salts*, above.)

Snake-bite.—Ligation above the wound, with excision of the part and searing with a hot iron; chlorine water, Labarraque's solution or Javelle water, iodine, ammonia, ammonium carbonate; artificial respiration.

Strychnine.—Tannin, potassium permanganate. (See *Alkaloids*, above.)

Tartar Emetic.—(See *Antimony*, above.)

Tobacco.—Tannin, then emetics. (See *Alkaloids*, above.)

Turpentine Oil.—Epsom salt, demulcents.

Wounds, Poisoned.—Ammonium carbonate, potassium permanganate, chlorine water. (See *Snake-bite*, above.)

Zinc Salts.—Sodium and potassium carbonates and bicarbonates, then emetics and warm demulcent drinks. (See *Metallic Salts*, above.)—SAMUEL O. L. POTTER.

ANTIDOTUM ARSENICI (Ger. Ph.).—A preparation almost identical with the *ferri oxidum hydratum cum magnesia* of the U. S. Ph.

ANTIDYSCRATICS are remedies credited with some special action in overcoming a dyscrasia. They include mercury, iodine, arsenic, antimony, and the lesser drugs popularly supposed to "purify the blood."

ANTIDYSENTERICS are remedies that are supposed to have a direct curative action in cases of dysentery. The most important of them is ipecacuanha.

ANTIFEBRINE.—See ACETANILIDE.

ANTIFERMENTATIVES.—See ANTIZYMOTICS.

ANTIFUNGIN.—A German proprietary preparation said to contain 15 per cent. of boric acid and a little acid magnesium borate, put forward by its maker as a remedy for diphtheria.

ANTIGALACTICS.—The measures that seem to be at all trustworthy as agents to check the secretion of milk are methodical compression of the breasts by bandaging or adhesive-plaster strapping, and the local use of belladonna in the form of an ointment or a plaster. Potassium iodide also has some advocates as a topical antigalactic.

ANTIGONORRHOICS.—See ANTIBLENNORRHAGICS.

ANTIHYDROPIN.—See BLATTA.

ANTIKAMNIA is an American proprietary preparation that has come into extensive

use as an analgetic and antipyretic. It is a white, crystalline, odourless powder having a slightly aromatic taste, soluble in hot water, almost insoluble in cold water, but more freely soluble in alcohol. It is probably one of the coal-tar products, or a mixture of one or more of those products with some other drug or drugs. Several analysts affirm that it is a mixture of acetanilide and sodium bicarbonate, and some say that it contains caffeine; as to this question, Dr. Hugo Engel, of Philadelphia (*Med. Summary*, Sept., 1892), says: "Upon the drug having been prepared in accordance with those formulæ, an article was produced bearing no resemblance to antikamnia." Whatever its composition may be, antikamnia seems to have a sufficiently definite therapeutic action to give it individuality as a drug.

As an *antipyretic* it acts rather more slowly than antipyrine or acetanilide, but efficiently, and it has the advantage of being free or almost free from any depressing effect on the heart; some observers even think that it exerts a sustaining action on the circulation. As an *analgetic* it is characterized by promptness of action and freedom from the disagreeable effects of the narcotics. It has been much used, and with very favourable results, in *neuralgia*, *influenza*, and various nervous disorders characterized by *melancholia*. The dose of antikamnia is from 3 to 10 grains, and it is most conveniently given in the form of tablets. Slight cyanosis has been observed when from 40 to 60 grains have been taken, and occasionally after taking not more than 30 grains.

ANTIKOL is said to be a mixture of 75 per cent. of acetanilide, 17·5 per cent. of sodium bicarbonate, and 7·5 per cent. of tartaric acid. Presumably it is intended for use under the conditions that call for the employment of acetanilide.

ANTILITHICS.—These remedies include all the measures that tend to lessen the accumulation of waste products in the system (for the most part the antarthritics and antirrheumatics), together with drugs that are supposed to exert a special action in preventing lithiasis or to dissolve calculous concretions.

ANTILUETICS.—See ANTISYPHILITICS.

ANTIMIASMATICS. — See ANTIPERIODICS.

ANTIMONY.—Metallic antimony is little used in medicine at the present time, although formerly pills of it having a cathartic effect were used and, on account of their having been recovered from the stools, were termed perpetual or family pills. Wine, water, and other fluids which had been allowed to stand for some time in cups made of this metal were found to have taken up small amounts of antimony and were used medicinally. *Finely powdered antimony* has within quite recent times been employed for the same purposes as its salts, but it is not very eligible. The most active and most important salt of this metal is the *tartrate of antimony and potassium*, *antimonii et potassii tartras* (U. S. Ph.), *antimonium tartaratum* (Br. Ph.), *tartarus stibiatus* (Ger. Ph.), or *tartar emetic*. It is also the one with which nearly all the physiological tests of the salts of antimony have been made, and the one which has been generally employed in case of criminal poisoning, and from which the vast majority of cases of accidental poisoning have occurred.

The effect of small doses of antimony and its salts, $\frac{1}{100}$ of a grain of tartar emetic, for example, if the dose is not too frequently repeated, is a slight feeling of uneasiness in the stomach, not unlike that of hunger. Somewhat larger doses give rise to nausea and vomiting, increase the secretion of the mucous membranes of the air-passages, of the alimentary canal (sufficiently to excite catharsis), and of the liver and pancreas; they also have the effect of a cardiac depressant and diaphoretic. The emetic action of antimony is not rapid, often being delayed for half an hour, but it is prolonged and depressing and accompanied by violent retching and straining.

When tartar emetic is applied to the skin or employed in enemata or intravenous injections the constitutional effects follow, and it has been used in such manner for the dislodgment of bodies impacted in the œsophagus, but this practice has been wholly superseded by the subcutaneous administration of apomorphine. The purgative effects are no longer thought desirable, but antimony is sometimes added to the saline cathartics to promote their action. If it is given with a small amount of water its emetic effects are the most marked, but if a large quantity of water is used the purgative action is most prominent. Where a cathartic effect is contra-indicated opium is often used to prevent it. Both these effects are increased by the simultaneous use of wine or acid fruits. The urine and perspiration and in nursing women the milk are the principal vehicles of its excretion.

Five grains of tartar emetic may be fairly regarded as the minimum fatal dose, although death has occurred in one case after the administration of 1½ grain, and, as is true of all poisons, phenomenally large doses have occasionally been followed by no ill effects. In *acute antimonial poisoning* there are nausea followed by persistent vomiting, a metallic taste, a burning sensation in the throat, œsophagus, and stomach, salivation, dysphagia, hiccough, cramps of the muscles, cold sweat, general coldness of the surface of the body, gastralgia, a pulse which progressively becomes weaker, diminished arterial tension, cyanosis, pinched face, amblyopia, slow respiration, suppression of the urine in some cases, and collapse and coma. The stools at first consist of fæcal matters, but become more and more fluid until they resemble the rice-water discharges of Asiatic cholera—that is, separate into a lower white and flocculent layer and an upper watery and almost clear layer. The entire condition has a strong resemblance to cholera, for which during the prevalence of this disease it might easily be mistaken. In some cases, and they are those in which the danger to life is greatest, the nausea and vomiting may be entirely absent, the sole effects being exerted upon the

heart and the nervous system. If death does not occur speedily an aphthous inflammation is set up and the characteristic antimonial eruption occurs around the margins of the anus and the nasal fossæ, about the genitals, and upon the skin of the abdomen. The post-mortem appearances will be aphthous inflammation of the mouth, pharynx, and œsophagus, with softness and erosion of the mucous membrane of the stomach, duodenum, cæcum, and rectum, all of which organs will have brown fluid contents, and the liver will be found enlarged and undergoing fatty degeneration, the heart sometimes flabby and relaxed, the kidneys fatty, and the lungs congested. The liver will always contain antimony and usually some sugar. In treating these cases the vomiting must be promoted by warm water, followed by milk and tannin (the chemical antidote) in some form or another, given in large quantities. If tannin itself is not at hand, nutgalls, strong green tea, and infusion of cinchona or of oak bark are appropriate preparations. The depression, pain, and diarrhœa must be combated with alcohol, ether, and opium, and such other remedies are to be used as the symptoms in each particular case may call for. Accidental poisoning may result from overdoses of such a preparation as antimonial wine or any one of a number of proprietary "soothing syrups" or cough mixtures, or in rubber works, type foundries, and other places where the metal is employed. Red rubber is given its colour by the red sulphide of antimony, but, as in the process of vulcanizing the two substances are so thoroughly incorporated, the danger of poisoning from this source is very remote. In places where antimony is melted some cases of poisoning have occurred from the inhalation of the fumes, but, as all commercial antimony contains arsenic, it is somewhat problematical as to which of these metals caused the trouble. Tartar emetic is sometimes used to destroy ants and a number of cases of accidental poisoning have occurred from lack of care in keeping it out of the way of children.

In *chronic antimonial poisoning*, of which there has been a large number of cases, with criminal intent, death has resulted either from the exhaustion consequent upon the long-continued disturbance of the digestive functions or from the constitutional effects of antimony upon the vital functions, especially those of the heart and the nervous system. Often it will be impossible, without a chemical analysis of the excretions during life or of the organs of the body after death, to determine whether the condition in question is one of poisoning, of dysentery, or of exhaustion and wasting due to some precedent disease. The difficulty of diagnosis during life is added to by the fact that if the initial doses are very small and progressively increased, a tolerance of their effects upon the stomach is established, the only symptom referable to that organ being perhaps a slight disgust for food which by itself is in no way characteristic, while the actual lesions of the alimentary canal are as well marked as in cases where nausea, etc., are present. Also, if 2 grains or so of tartar emetic are dissolved in a quart of water, small doses may be given at frequent intervals, and they will purge violently and cause a condition simulating dysentery, without giving rise to any gastric disturbance. The symptoms observed in chronic antimonial poisoning are nausea, disgust for food, vomiting of the food, mucus, and bile, diuresis (the reverse occurring in chronic arsenical poisoning), alternate constipation and diarrhœa, a quick and weak pulse, paleness of the face, an anxious countenance, muscular weakness, a cold surface, clammy perspiration, jaundice, salivation, increased secretion from the pharynx, a coated tongue, amblyopia, dyspnœa, a sense of oppression in the head, tympanites, colic, abdominal tenderness, enlargement of the liver, loss of flesh, in some cases the characteristic eruption in the localities mentioned above, and collapse. It need hardly be stated that not all these symptoms will be present in all instances, and that a diagnosis, when those referable to the alimentary canal are not well marked or are lacking, is a matter of extreme difficulty and, in fact, impossible unless the presence or absence of antimony in the excretions is settled by the aid of analysis. There is nothing special in the treatment of this condition beyond the instant stoppage of the administration of the antimony and the adoption of measures to relieve the irritation of the alimentary canal and to support the strength. The post-mortem appearances may be very slight, consisting of little more than evidences of long-continued irritation of the stomach and intestines, but in some cases the appearances noted under the head of acute poisoning will be present in a greater or lesser degree. Whatever may be found, it will hardly be distinctive of this form of poisoning. The liver and kidneys will reveal the presence of antimony, and so probably will the contents of the intestines and bladder.

Tartar emetic, or the *tartrate of antimony and potassium*, is the only salt of antimony which is of definite chemical composition, and, with the exception of the terchloride, or butter of antimony, is the only one which can be relied upon as being free from arsenic. Moreover, as it possesses all the medicinal properties of the metal, it is the preparation which is in every way the most desirable to use. The cardinal rule to be observed in the employment of antimony is its avoidance in all cases except in the plethoric, or where, if nothing else can be obtained, its depressing properties will be counterbalanced by the possible benefits to be derived from its employment. It may be added that, unless in isolated cases, its administration to the young is attended with more or less danger. As an emetic in cases of poisoning it is not to be recommended, as its action is slow and its effects are prolonged and debilitating. Whenever it is used as an emetic, if the first dose does not act, some other drug or preparation must be substituted. Its use has been suggested in the treatment of *chorea*, in some cases of which emesis proves of value, but, as there is nothing specific alleged for this particular drug, one which is speedier in its action and less debilitating is more desirable. In the

acute and forming stages of all *catarrhal disorders of the respiratory tract* doses of $\frac{1}{20}$ of a grain, frequently repeated, but not often enough to cause nausea, will usually either abort the attack or shorten its course. For these purposes the compound-licorice mixture and James's powder are often used, but possess no advantages over tartar emetic. When a dry cough accompanies these conditions the addition of ammonium chloride and opium is advisable. Tartar emetic is one of the ingredients of a large number of proprietary cough mixtures. *Asthma* is one of the diseases in which great reliance was formerly placed on antimony, but, except in those cases where the attack is set up and maintained by an overloaded stomach and when emesis seems proper, it is to be avoided. *Puerperal fever*, *mammitis*, *orchitis*, and other acute inflammatory conditions in the plethoric are sometimes benefited by its use in small doses frequently repeated, but the utmost caution must be observed to avoid carrying the depression beyond the point of safety. For the reduction of the temperature and the promotion of diaphoresis in *sthenic fevers* antimony stands next to aconite in efficiency, but the latter is much safer and is to be preferred. *Acute indigestion* is perhaps the only condition in children in which the use of tartar emetic is permissible, and then it may be given in doses of $\frac{1}{100}$ of a grain every hour until $\frac{1}{4}$ of a grain has been taken. In *sthenic noisy delirium* and *mania*, when everything else fails to produce quiet and rest, small amounts may be combined with opium, and good results follow; but, as in so many of these cases the period of excitement is followed by one of depression, the greatest caution must be exercised. In the past a large number of conditions have been treated with this drug, and from time to time attempts are made to revive its use, but, with the exceptions already noted, its disadvantages more than counterbalance its advantages, and its employment should be adopted only after the most serious consideration.

The external application of tartar emetic, either powdered, in solution, or in the form of an ointment, is followed by an eruption which, at first vesicular, becomes papular and then pustular. The pustules are umbilicated and resemble those of small-pox, for which the eruption has sometimes been mistaken. If the action of the drug is allowed to continue beyond a certain point, sloughing and even gangrene may occur, especially if the skin at the point of application was broken or very thin. When the general temperature of the body is above the normal, less local reaction may be expected. Formerly this eruption was induced for purposes of counter-irritation in chronic disease of the lungs, etc., but, on account of its great harshness and the danger of constitutional effects from absorption of the antimony, it is no longer employed. It was also used formerly to obliterate *nævi* and *superficial varicose veins*. In cases of *strangulated hernia*, *rigidity of the os uteri* during labor, and *dislocations*, nauseating doses may be used with a good deal of success; but it need hardly be stated that an anæsthetic is to be preferred if it is obtainable.

Doses of from $\frac{1}{20}$ to $\frac{1}{6}$ of a grain of tartar emetic, repeated every two hours, are diaphoretic and expectorant; in doses of from $\frac{1}{4}$ to $\frac{1}{2}$ a grain it acts as a nauseant and sudorific, and in 1-grain doses as an emetic.

The *oxide of antimony* is rarely used, except in the form of James's powder. It may be given for its emetic properties in from 2- to 4-grain doses, but it is very slow in its action.

The *oxysulphuret*, or *kermes mineral*, is emetic in doses of from 5 to 20 grains, but is very uncertain in its action.

The *sulphuret*, or *crude antimony*, has entirely gone out of use, except for the preparation of the various salts of the metal. It was formerly given in 5- to 15-grain doses.

Sulphurated antimony, or the *golden sulphuret of antimony*, is no longer used by itself, but is contained in the compound antimony pills.

The *antimonial wine* of the pharmacopœias contains 1 part of tartar emetic in about 250 parts, and is diaphoretic and expectorant in doses of from 10 to 20 drops, depending upon the age and strength of the patient, but it is rarely used as an emetic, as the amount of wine in a dose large enough to be effectual interferes with its action.

The *compound pills of antimony* of the U. S. Ph. and the *compound calomel pills* of the Br. Ph., popularly known as *Plummer's pills*, contain $\frac{1}{2}$ a grain each of calomel and sulphurated antimony and 2 grains of guaiacum. They have been employed in the treatment of *rheumatism* and *cutaneous disorders*, especially those of a *syphilitic* origin, and are said to have been devised for the purpose of affording an opportunity to prescribe a mercurial without the patient's knowledge.

Crude or *black antimony*, or *antimony sulphide* or *trisulphide* (*antimonii sulphidum* [U. S. Ph.], *antimonium nigrum purificatum* [Br. Ph.], *stibium sulfuratum nigrum* [Ger. Ph.]), and *sulphurated antimony*, or *kermes mineral* (*antimonium sulphuratum* [U. S. Ph., Br. Ph.], *stibium sulfuratum aurantiacum* [Ger. Ph.]), are used in veterinary medicine and in making other antimonial preparations.

Antimonial powder, or *James's powder* (*pulvis antimonialis*), is an intimate mixture of 33 parts of antimony oxide and 67 of precipitated calcium phosphate (U. S. Ph.), or of 1 part of antimony oxide and 2 parts of calcium phosphate (Br. Ph.). It may be given in doses of from 3 to 8 grains.

The Br. Ph. authorizes a *liquor antimonii chloridi*, or *solution of antimony chloride*, which is used in 5- to 10-drop doses, and a *tartar-emetic ointment* (*unguentum antimonii tartarati*), which is employed as a counter-irritant and vesicant.

Diaphoretic antimony is official in the Fr. Cod. as *antimoine diaphorétique lavé*, and may be given in 8- to 30-grain doses, but it is an uncertain and untrustworthy preparation.

The *protochloride* or *trichloride*, or *butter of antimony*, has sometimes been used as a *caustic* and *vesicant*.—RUSSELL H. NEVINS.

ANTINARCOTICS are agents that resist the action of narcotics. Some of them, like coffee, tend to prevent sleep in persons who have not taken a narcotic. There is no drug that is antagonistic to all narcotics, and the expediency of considering the so-called antinarcotics as a class of remedies is questionable.

ANTINERVIN is a German proprietary antipyretic and analgetic, said to consist of 1 part each of ammonium bromide and salicylic acid and 2 parts of acetanilide. It is given in doses of from 8 to 25 grains, four times a day.

ANTINEURALGICS.—See under ANALGETICS.

ANTIPARASITICS are agents that destroy animal and vegetable parasites. Practically, they embrace those that are employed in the treatment of parasitic skin diseases (to which alone this article relates) and the anthelminthics, which are treated of under that name.

In the treatment of skin diseases antiparasitics play a very important part. It is not only in those affections that have been most commonly and distinctively classed as "parasitic" that these agents are required, but also in many other diseases of the skin in which the presence of parasites constitutes an essential if less obvious factor in the ætiology. The parasitic diseases of the skin have been commonly divided into those due, on the one hand, to animal, and, on the other, to vegetable parasites—the former including more particularly scabies and phtheiriasis, and the latter such affections as ringworm, favus, and chromophytosis. Manifestly, these can represent only a small part of the cutaneous diseases which are attributable either wholly or in part to parasitism. According to modern pathology, lupus, syphilis, leprosy, and all the infectious granulomata of the skin are really parasitic diseases, and none the less because the parasite is less easily found than in such diseases as scabies and ringworm. Nevertheless, though a large proportion of the remedies employed in these infections granulomata are potentially antiparasitic, it is by no means certain that they necessarily act solely, or even chiefly in that way. Their main action is often doubtless exerted on the involved tissues rather than upon the parasite, and, though incidentally the latter may be destroyed, the therapeutic action is no more antiparasitic than that of treatment that was simply ectrotic would be. Thus, in the case of the mercurial applications so efficacious in the syphilodermata, it is a question whether the effect is not due as much to a discutient or resorbent as to a germicidal action. The same may be said of the so-called antiparasitic treatment of *lupus*. While the pyrogallic acid, the iodoform, the mercurials, and other like applications that have proved more or less serviceable in this disease would, perhaps, have some effect in sterilizing the tissue or in destroying the tubercle bacilli, their action may also be otherwise explained. James C. White, Doutrelepont, and others have reported successes in the treatment of the same disease by the continued application of a solution or ointment of the *bichloride of mercury*. Doutrelepont uses a solution of 1 in 1,000 under gutta-percha tissue, and both he and Auspitz have recommended the injection of a 1-per-cent. solution into the lupus tissue. The *rationale* of this treatment is based entirely on the germicide theory. The favourable results that have been reported have not been generally confirmed by the experience of others. Upon the same theory, perhaps, *potassium permanganate* has been employed in superficial and recent cases. A 10-per-cent. solution is painted on every day until a thin black crust is formed, under which the nodules soften and can then be removed easily. As to the *tuberculin* treatment of lupus, which has already become almost obsolete, it was not maintained that its action was directly germicidal to the tubercle bacilli, and hence, properly speaking, it could not be termed antiparasitic. In *lepra* antiparasitic treatment has made even less progress than in syphilis or in lupus.

But there are other diseases besides these infectious granulomata which, though parasitism plays an important part in their ætiology, are not commonly classed as parasitic diseases, but in which, nevertheless, antiparasitics are strongly indicated and are, furthermore, often essential to a cure. They are distinguished from the nominally parasitic affections in that, while in the latter the parasite is of the nature of the *Hyphomycetes*, in the former the parasitic organisms belong to the class of *Schizomycetes*. Thus until recently a distinction was made between two diseases commonly affecting the region of the beard—*sycosis parasitaria* and *sycosis non-parasitaria*. The fact is now recognised that both are parasitic—the former a hyphomycetic, the latter a schizomycetic disease—and that in the latter, as well as in the former, antiparasitic treatment is called for. It is true also in *pustular* and *suppurative skin diseases* generally, more especially in those that produce an autoinoculable pus, that the best results are obtained with remedies that are germicides. The efficacy of *hydrogen peroxide* in such diseases is doubtless due not only to its disintegrating effect on the pus cells, but also to its power of destroying the streptococci of suppuration—the same power that makes such remedies as the sulphur preparations, silver nitrate, potassium permanganate, europhene, and other antiseptics so useful in these diseases.

Again, there is a large proportion of the cases of *eczema* in which there is a parasitic element that tends to modify and prolong the disease—even if it is not the primary cause of the inflammation—which must be eliminated by antiparasitic treatment before the disease will disappear. This is especially true of that variety known as *eczema seborrhoicum*, in which the presence of parasitic organisms, though not clearly demonstrable by ocular proof, is pretty universally admitted, together with the fact that in the treatment of the affection the use of germicides is indispensable. The most efficient remedy employed in this disease is

resorcin, either in solution or in ointment, in strengths varying from 1 to 10 per cent. Other efficient remedies acting in a similar way are preparations of *sulphur* or *ichthyol*, the *bichloride of mercury* or other mercurial, *salicylic acid*, and sometimes *chrysarobin*.

But not in this form only, but in many other instances eczema acquires a parasitic character and is amenable only to antiparasitic treatment; and this is said without reference to that variety known as eczema marginatum, which is due to the *Trichophyton*. In the forms now referred to the nature of the parasites is seldom certainly known, though presumably they belong to the *Schizomycetes*. As the subject is more and more studied and understood the continual tendency is to attach greater and greater importance to these parasites in the ætiology of skin diseases generally, and more and more to enlarge the scope of antiparasitic remedies.

Turning now to those affections to which—because the parasite is more easily detected and more obviously the cause of the disease—the term "parasitic diseases" has been technically and somewhat exclusively applied, we find here the employment of antiparasitics still more definitely indicated, as well as more effectual. Indeed, almost the sole indication for treatment is the destruction of the parasite, for when that is removed the patient gets well. As already mentioned, these affections are commonly divided into those due to the presence of animal parasites on the one hand and those due to the growths of filamentous fungi (*Hyphomycetes*) in the skin on the other.

The epizoa most easily destroyed are those which are found on the outside of the skin. Those that burrow in the skin are less accessible, and hence less easy to kill. The *Pediculus corporis* inhabits the clothing and there lays its eggs. It is the clothing, therefore, in this case that must receive the antiparasitic treatment. The usual method is to expose the infested articles for some hours to a *high temperature*—of 200° F. or more—either in a disinfecting oven, in a steam bath, or in boiling water. The destruction of *pediculi capitis* as well as *pediculi pubis* is somewhat more difficult. In dispensary practice the usual and very effectual method for lice in the head is to apply *kerosene oil* plentifully, leaving it on all night. This, however, though it kills the pediculi, does not always destroy all the nits which are fastened to the hairs. A lotion of *acetic acid* or *common vinegar* will loosen them, after which they can be removed with a fine comb. A better way, of course, if it is practicable, is to cut the hair close or shave it. *Ammoniated mercury* ointment, preferably made with vaseline, is often used both for pediculi capitis and for pediculi pubis; also a solution of the *bichloride of mercury* in the strength of 2 to 5 grains to the ounce, or a 3- to 4-per-cent. alcoholic solution of *carbolic acid*, *naphthol* 5 per cent. in oil, decoction or tincture of *larkspur* seeds, decoction of *Cocculus indicus*, and, as effectual both against the pediculi and the nits, the combination of 6 drachms of a 5-per-cent. *oleate of mercury* with 2 drachms of *ether* have been recommended.

In *scabies*, inasmuch as the parasite burrows into the epidermis, the simple application of the parasiticide to the surface is hardly sufficient. Some special or preparatory treatment is required to soften the cuticle and lay open the cuniculi. This is often accomplished by means of a prolonged bath, together with frictions with green soap, after which an antiparasitic is well rubbed in. For the latter, *sulphur* in some form is used more generally than any other remedy. The simple dry powder has been recommended, but it is more commonly used in an ointment. Hebra's ointment is composed as follows:

℞ Sulph. sublim.,
Ol. cadini............ āā ʒ ij;
Cretæ præp............. ʒ ijss.;
Sap. virid.,
Adipis................ āā ℥ j.
M.

Helmerich's stronger preparation is the following:

℞ Potass. carbonat.......... ʒ ij;
Sulph. sublim............ ʒ iv;
Adipis.................... ℥ iij—ʒ ij.
M.

An effectual method is to immerse the patient for half an hour in a bath consisting of four ounces of *potassium sulphide* dissolved in four gallons of water at a temperature of 100° F. At intervals during the bath the skin is well scrubbed with a stiff brush. Another excellent remedy is *β-naphthol*, as in the following prescription:

℞ β-naphthol............... gr. xl;
Saponis viridis........... ʒ ijss.;
Cretæ præp.............. ʒ ss.;
Adipis.................. ℥ ss.
M.

The pure *balsam of Peru*, after a prolonged bath, and the *styrax liquida* are also serviceable, though they are milder antiparasitics. All these applications require to be repeated three or four times, but seldom over a longer period than two days.

In the case of certain other animal parasites that are found beneath the surface of the skin, such as *Pulex penetrans* and *Filaria medinensis*, the only antiparasitic treatment required consists in an operative procedure for their removal.

The three vegetable parasites (*i. e.*, filamentous parasites) that most commonly affect the skin are the *Microsporon furfur*, the *Trichophyton tonsurans*, and the *Achorion Schönleinii*, producing the diseases known as *chromophytosis*, *ringworm*, and *favus*. The first of these it is comparatively easy to destroy, lying near the surface as it does and never affecting the hair follicles. The great difficulty is to prevent recrudescences, which are exceedingly apt to occur. The fungus is destroyed by any one of a great number of germicides—a solution of *mercury bichloride*, or *sodium hyposulphite*, *tincture of iodine*, *chrysarobin*, and even frictions with *green soap*, but after the disease

has apparently been cured the skin should be treated for a long period with milder antiparasitics, among the best of which is a 2- to 3-per-cent. solution of *resorcin* in water and alcohol or cologne.

In *ringworm*, when affecting the non-hairy parts of the body, the destruction of the parasite is not difficult and there is but little danger of its recurrence. Even when the region of the beard is affected, from the very violence of the inflammation that usually accompanies it the hairs are spontaneously loosened, the fungus escapes in the pus, and the duration of the disease is not usually very protracted. But when the scalp is invaded, the extent of surface involved and the liability to reinfection are so great that very assiduous and often prolonged antiparasitic treatment is necessary before the disease is at an end. It is of great advantage in the treatment to shave or closely clip the hair at least over all the region evidently affected. In recent cases *epilation* may sometimes be dispensed with when the roots of the hairs show no sign of disease. These are the simplest cases, and often yield readily to a short course of treatment. In all forms of ringworm probably the most effective antiparasitic is the *bichloride of mercury*, and it may be used in either alcohol and water, oil of turpentine, tincture of benzoin, or collodion, the solution varying in strength from 1 to 5 or 10 per cent. *Chrysarobin*, though also an efficient remedy, is objectionable because of the troublesome dermatitis it often causes (which is prone to extend to the conjunctivæ) and because it discolours the hair when the latter is not cut. It is nevertheless suited to some cases of circumscribed ringworm, and is preferably applied in flexible collodion. *Tincture of iodine*, the *oleates of mercury* and *copper* (5 to 10 per cent.), *naphthol plaster*, *ethylate of sodium*, *hyposulphite of sodium* or solution of *sulphurous acid*, and many other antiparasitics will destroy the fungus if properly and persistently enough applied. In some cases, in order to evacuate the diseased follicles it is well to produce suppuration, as by *croton oil*, which is not only rubbed over the affected patches, but in certain inveterate cases may be carried directly into the follicles by means of a finely sharpened quill or a blunt-pointed gold pin. It is important that the treatment pursued should be systematic and not desisted from till all desquamation has ceased and a crop of strong hairs has begun to grow.

After the removal of the crusts by prolonged applications of oils or poultices, *favus* of the scalp is treated with much the same antiparasitics as are used in ringworm. *Epilation* also is necessary here, though, according to Kaposi, it need only be practised on the diseased and loosened hairs.—EDWARD B. BRONSON.

ANTIPERIODICS are a class of drugs whose efficiency lies in their power to relieve and to cure those diseases of which periodicity or the regular recurrence of paroxysms is the characteristic. Strictly speaking, the name antiperiodics is properly applied to drugs which are antagonistic to all diseases in which periodical recurrence of paroxysms is the feature, but practically the name is employed in reference to those drugs which are effective only against *malarial diseases*, for in intermittent fever periodicity appears in its most regular and typical form, and in other diseases of which periodical paroxysms are the characteristic, drugs of specific action are unknown, so that for them, therefore, there can at present be no antiperiodic. Of this latter class relapsing fever offers the best example, for of specific treatment of its paroxysms there is none. Clinically, then, by antiperiodics we mean agents that are curative of malarial disease.

Though many drugs have from time to time been put forward as claimants of antiperiodic honours, the four official alkaloids of cinchona —*quinine*, *quinidine*, *cinchonine*, and *cinchonidine*—alone are to be regarded as specific, and, though all of them are effective, yet quinine is the most potent. Besides its action as a curative agent, quinine is of great prophylactic efficiency, and in case of exposure to malarial infection from 5 to 10 grains of quinine taken each morning in black coffee will generally serve to prevent infection. For aborting a paroxysm of *intermittent fever*, quinine should be given at least six hours before the expected seizure, since its maximum effect is obtained only after five hours following its administration. For this purpose, in ordinary cases, from 5 to 15 grains will suffice, though in severe cases much larger doses may be required, and, if it is thus employed, there seems to be a marked advantage in giving the amount in one dose rather than in divided doses. If time permits, the activity of the quinine will be promoted by purgation, preferably by a mercurial, and for greater rapidity of action the quinine should be given in solution. Should it be impossible to so far anticipate the paroxysm, quinine should still be given, for, even if the attack occurs, it will to some extent be modified and lessened by the previous administration of quinine. Should time be exceedingly brief, however, and especially if the prevention of the paroxysm is of extreme importance, as is the case in *pernicious intermittent fever*, the administration should be done by the hypodermic method. The administration of quinine for curative effect should regularly be continued between the paroxysms in divided doses. From 10 to 20 grains a day should be given in cases of ordinary severity, in solution, or, more pleasantly, in pill. For severer cases doses much larger may be required. While it is true that purgation is not necessary to the effectiveness of quinine, it is equally true that the administration of a *mercurial purge* at the beginning of a course of quinine will add to that effectiveness, both by promoting absorption and by relieving those intestinal derangements that are so often the accompaniment of malarial infection.

Arsenic, though in no sense a rival of the cinchona alkaloids in antiperiodic value, must still be given rank next after those drugs, for in *intermittent fever*, especially in old cases—cases indeed which sometimes resist the ac-

tion of quinine—it is often highly effective. It is, however, slow in its action, and must be given for a considerable length of time and in full doses.

Eucalyptus was at one time highly esteemed in the treatment of the malarial fevers, and, though further experience with it has proved it to be devoid of specific antiperiodic power and has convinced the majority of observers that the slight value it possesses in such conditions is due simply to its bitter character, a value it has in common with a large number of the simple and aromatic bitters, yet for one purpose it is apparently of greater service in malarial disease. This is the effect the growing tree appears to have in diminishing malaria in moist and marshy regions in which that poison prevails—an effect which is believed to depend upon the rapidity of its growth and the enormous amount of water consumed in that growth. In malarious regions the planting of *Eucalyptus globulus* appears to have been followed by good results.

Many other drugs have from time to time been recommended for a supposed antiperiodic value, among them many of the *simple* and *aromatic bitters*, and there seems to be little doubt that in cases of great mildness a bitter tonic will often suffice to relieve malarial disease. Especially prominent among these are *cornus*, *eucalyptus*, *magnolia*, and *dita bark*.

What has been said of the bitters is equally true of the *aromatics*, for in mild cases they may be most serviceable, and in combination with one of the cinchona alkaloids, as in the celebrated *Warburg's tincture*, serve to increase the effectiveness of the alkaloid. To this class belong *apiol*, *piper*, and *capsicum*.

Warburg's tincture ranks high in the list of antiperiodics, and has gained for itself a reputation well deserved. Especially is it effective in severe cases and in cases of long standing, and, though its value undoubtedly depends principally upon the quinine it contains, yet its aromatics and its bitters contribute in no small degree to its action. It is sometimes known as "*antiperiodic tincture*" (*tinctura antiperiodica*), and may be prescribed with or without aloes, the name Warburg's tincture (unqualified by the words "without aloes") referring to that form which contains aloes.

The composition of the tincture without aloes as given in the *National Formulary* is as follows:

Rhubarb	448	grains.
Angelica seed	448	"
Elecampane	224	"
Saffron	224	"
Fennel	224	"
Gentian	112	"
Zedoary root	112	"
Cubeb	112	"
Myrrh	112	"
White agaric	112	"
Camphor	112	"
Quinine sulphate	1280	"

Diluted alcohol, enough to make 8 pints.

Each fluid ounce, therefore, contains about 10 grains of quinine sulphate. Warburg's tincture with aloes is made by adding 28 grains of aqueous extract of aloes to a pint of the tincture without aloes. The usual dose of Warburg's tincture is ½ oz., which dose may be repeated if necessary in three or four hours, and it is usual during its administration to have the patient abstain from food and drink. It may be more conveniently and pleasantly administered by concentrating the tincture and administering it in capsules, and the tincture thus concentrated is readily obtainable of apothecaries.

Other remedies have been largely used in intermittent fever, but in no way deserve the title antiperiodic. Thus, salicylic acid and its salts, as well as salicin, antipyrine, and acetanilide, may be at times effective, but purely as antipyretics.

In the same way drugs used to abort a paroxysm of intermittent fever, though often effective, are in no sense truly antiperiodic. Thus are given chloroform internally and by inhalation, nitrite of amyl by inhalation, nitroglycerin and laudanum internally, and a combination of ⅕ of a grain of pilocarpine hydrochloride and ⅛ of a grain of morphine sulphate hypodermically.—Henry A. Griffin.

ANTIPHLOGISTICS are those procedures and drugs which, acting by depressing and lowering vital energy, combat febrile and inflammatory disease. The term antiphlogistic is not commonly used at present, and, though conveying a well-defined idea of the action of certain drugs and procedures, it is in reality a relic of those days in which the therapeutics of all febrile disease and inflammation, especially if sthenic, consisted in the artificial production of adynamia to counteract the supposed pathologically dynamic state. This was exemplified in the practice of bloodletting—a practice which in every sense is the type of antiphlogistic treatment. The views of the present day, however, are not in accord with these beliefs, and with the practical abandonment of bloodletting has come a much less frequent employment of antiphlogistic methods, with, consequently, a relatively infrequent use of the word antiphlogistic itself.

Bleeding, however, is occasionally done at the present time (see Bloodletting), and indeed ought to be more frequently employed, but the practitioner of the present day prefers the use of those circulatory depressors which, acting to diminish the force of the heart's action and to dilate the peripheral vessels, have a similar action in relieving an overexcited circulation. Of such drugs the most useful as well as the most prominent are *aconite* and *veratrum viride*, which, given in the early days of acute sthenic inflammations, frequently serve to cut short the disease process or at least to modify it favourably. *Antimony*, too, is employed in the same way and is often quite as effective, but its use at the present time is one of moderation. Formerly it was not so, however, and in old-time antiphlogistic practice the antimonial was the partner of bloodletting. In those days if bleeding was not done, and perhaps if it was, the antimonial

was administered in such amounts that the condition of the patient became one of perspiring and nauseated relaxation the continuance of which was limited only by the duration of the disease or of himself.

The use of *cathartic drugs* is another form of the antiphlogistic therapeutics of the present day, and in the mercurial and the saline cathartics we have drugs which, given early in sthenic inflammations, are undoubtedly of the greatest benefit. Especially to be recommended are frequently repeated and small doses of *calomel* and *magnesium sulphate.*

Diaphoretics are also entitled to the position of antiphlogistics, for, though their action is less violent and often less marked, yet they are apparently similar in action to cathartics and often little or no less efficient.

Diet may be decidedly antiphlogistic, and, though it is now seldom carried to the point practically of starvation, as it was in the era of bleeding, yet a reducing diet is still observed in sthenic inflammations, and with wisdom and benefit. How it is that these procedures are effective is quite unknown; it may be that by lessening blood-pressure they reduce the tendency to exudation; it may be that they remove from the circulating fluid matters of a poisonous nature; perhaps they promote the elimination of diseased cells; but all explanation is theory indeed, for of a proved cause of their effectiveness we are ignorant. In addition to the systemic antiphlogistics, which indeed have more or less indirect action upon local inflammations, there are means of combating such inflammations by direct application to the affected areas, which, acting to deplete and relax, are entitled to the name *local antiphlogistics.* Of these are *local blood-letting*, *wet cupping*, and *leeching.* Similar effects, too, are produced by the local applications of *heat* and *cold*, as well as of some of the *astringents* and of *belladonna* and perhaps *ergot.* Such results, however, are accomplished not by the depletion and relaxation necessarily the action of antiphlogistics, but rather by a power to constringe and to contract vascular tissues. Locally applied, antiseptics also may produce such results, but not by antiphlogistic action, for their powers are specific, and if depletion and relaxation result they are but secondary and coincidental. *Interstitial injections*, too, are practised for the same purposes, but these again are not antiphlogistics, but rather antiseptics.—Henry A. Griffin.

ANTIPHTHEIRICS, or **ANTIPHTHIRICS,** are those antiparasitics that are employed to destroy lice and their nits (see under Antiparasitics).

ANTIPHTHISIN is a sozalbumin isolated by Edward Klebs from cultures of the tubercle bacilli. He separated from tuberculin alkaloids that are soluble in alcohol and that produce depression of the heart; a toxalbumin that produces fever, malaise, nausea, and vomiting; and a sozalbumin that is not poisonous and that has cured tuberculosis in Guinea pigs and apparently in the human subject. He regards it as the germicidal part of tuberculin.

The culture fluid is freed from bacilli by filtration, mixed with orthocresol, then added to an acetic-acid solution of iodide of sodium and bismuth, with the result of forming a precipitate; the solution is filtered, the filtrate is made alkaline, the bismuth salt is removed by means of a water-bath, and then the solution is slightly warmed and filtered again. The last filtrate, which is as clear as water, is mixed with absolute alcohol, which forms a precipitate, then this is freed from the alcohol and redissolved in sterilized water and a 0·2-per-cent. solution of orthocresol in glycerin is added until the product contains 1 per cent. of glycerin. The quantity of the soluble substances amounts to from one tenth to one half of the original culture fluid, so that a double, quintuple, or decimal concentration of the effective substance is produced. Experiments on man and animals have shown that a quadruple concentration of antiphthisin acts as energetically as pure tuberculocidin prepared from crude tuberculin.

Klebs maintained that antiphthisin was entirely destitute of the toxic properties of tuberculin, the alkaloids and toxalbumins of which were eliminated. In the human subject its administration in doses several thousand times as great as that of tuberculin has produced no depressing effect upon the heart, no fever or inflammatory symptoms, and no other undesirable effects. In from eighty to ninety per cent. of a series of cases of *pulmonary tuberculosis* he produced improvement by the administration of antiphthisin, and in the earlier stages of pulmonary tuberculosis arrest and apparent cure of the disease uniformly occurred.

The writer is indebted to Dr. Karl von Ruck, of Asheville, N. C., for an account of his experience with the agent. Dr. von Ruck attests its absolute safety and considers that it has curative properties. At the time of the account he had treated sixty-one patients with it in his private sanitarium. Of four patients with incipient tuberculosis, three had been discharged apparently cured and one was still under treatment, though recovering. Of twenty-one patients in the second stage, five had been discharged apparently cured, two had been very greatly improved, and four had so improved that they had demanded their discharge. The remainder were still under treatment when these data were furnished. Of thirty-three patients in the more advanced stages, thirty-one had manifestly improved, and the two that had not improved suffered with severe intestinal tuberculosis. Of three patients that had died, there had been pneumothorax in two and amyloid degeneration in one; in each of these cases the necropsy had shown that there was no new or recent tubercular lesion, and the pulmonary cavities had smooth, fibrous walls surrounded by air-containing parenchyma.

Dr. von Ruck states that fever is no contraindication to the use of the agent, and that, in so far as the fever is due to the purely tubercular process, it yields rapidly to large doses. Following the administration of the substance a diminution of percussion dulness and a

clearing up of previously dull areas have frequently been observed. The cough and expectoration are favourably influenced, and, unless the sputum comes from cavities, the tubercle bacilli show rapid degeneration and disappear entirely. The improvement in temperature, pulse, respiration, and general physical condition, as well as the subjective sense of improvement experienced by the patient, was obtained in comparatively short periods of time, usually within the first few weeks, the improvement being more rapid when large doses were administered.

When the remedy is applied to *tubercular ulcers*, they become clean and after a few applications show a tendency to heal.

Antiphthisin may be administered hypodermically or by rectal injections. The dose to begin with is from 0·1 to 0·5 c. c., and it is gradually increased according to the severity of the case, as much as 10 c. c. being given daily for several weeks. It is recommended for use only in the earlier stages of tuberculosis, and does not relieve complications, such as those produced by other pathogenic germs. It acts only upon living tubercular tissue and upon the tubercle bacilli within reach of the circulation, its specific effect being most rapid and distinct in vascular regions.

Where, in consequence of the liberation of toxic products due to the destruction of large numbers of tubercle bacilli and the absorption of a quantity of tubercular tissue, any bad effects manifest themselves, the use of the remedy may be intermitted for two or three days until the untoward symptoms have ceased.

Where doses larger than 1 c.c. are administered, the quantity given should be divided, one half being injected in the morning and the other half in the evening. If the hypodermic injections produce local irritation, antiphthisin may be diluted with a small quantity of distilled water and injected into the rectum. Antiphthisin may be obtained from Dr. von Ruck in this country, or from Klebs's laboratory in Strassburg.—Samuel T. Armstrong.

ANTIPLASTICS.—This term is used in two senses: first, to include measures which are supposed to moderate *corpulency;* second, to designate such drugs as mercurials, to which is attributed the property of checking or limiting *plastic inflammatory exudation* such as occurs in membranous croup, and the preparations of iodine, which have been thought to give rise to atrophy of certain glands, especially the breast and the testicle, or to reduce *hypertrophied glands*, such as the thyreoid and the lymphatic glands. In the first sense, it includes regulation of the diet and the use of evacuants; in regard to the second sense, the reader is referred to the articles on Mercury and on Iodine.

ANTIPRURITICS.—See Anticnesmatics.

ANTIPYONINE is a trade name of a substance described as white, unctuous to the touch, tasteless, neither caustic nor poisonous, absolutely harmless, and of great solubility. It is said to be a polyborate of sodium. It has been used in ophthalmic practice to control and prevent *suppuration* in affections of the cornea and conjunctiva and after enucleation of the eye. Weak solutions answer for the ordinary forms of *keratitis* and *conjunctivitis;* stronger ones are required for *corneal ulcers*, *pannus*, and *follicular* and *granular conjunctivitis;* and very strong ones may be used in cases of *purulent conjunctivitis*, in those of *panophthalmitis*, after enucleation, and in the treatment of large wounds of the eye. M. Bocquillon-Limousin, from whose *Formulaire des médicaments nouveaux* the foregoing has been condensed, does not give the strength of the various solutions.

ANTIPYRETICS are remedies to reduce fever. *Fever* is a symptom and not a disease, but it is such a frequent expression of disease that it is commonly used as a synonym. It is needless to state that many diseases, even fatal diseases, run their entire course without fever. Nevertheless, in a general way, the height and duration of fever constitute a criterion of disease. The range of fever is in many cases so definite as actually to describe the nature of the disease. The study of fever has always been an inviting field to the pathologist and physician, but, notwithstanding the immense research of the centuries, the absolute cause of fever remains as yet unknown. Fever is produced by many, sometimes by trivial, causes. Thus the so-called thirst-cure may excite a fever of from one to three degrees. The mere connection of an artery with a vein, as, for instance, the transmission of blood from the artery directly into the crural vein without intervention of the capillaries, may be attended with a sharp attack of fever (Stricker). Every loss of blood not too excessive may also be followed by a similar increase of temperature. In these cases there is certainly no penetration of the body by a new or foreign pyrogenic material. The fever may here depend only upon retrograde products of the body itself. The same is true of the fever which follows the introduction of small quantities of distilled water. Every marked lesion of the red blood-corpuscles which leads to hæmoglobinæmia and hæmoglobinuria is attended with a sharp attack of fever. Resorption fever is caused by the absorption of exudations through the lymph vessels into the blood.

Individuals differ with regard to fever. Certain nervous persons may have a sharp attack of fever after a severe psychical excitement, especially after a fright. Gallstone colic is attended with an attack of fever much like the paroxysms of intermittent fever (Frerichs). Best known is the so-called urethral fever, which follows a painful catheterism, sometimes even with fatal course. It also resembles intermittent fevers. There are people who are attacked with fever by reason of an excitement of the cutaneous nerves, as by change of linen or by sleeping in a cold bed, when they may be seized with a violent chill, with chattering of the teeth and consecutive fever (Lewin).

Since the discovery of the relation of micro-organisms to infection the attempt has been

made to discover in them or their products some peculiar chemical body which would account for the fever. As long ago as in 1875 Richardson found in decomposing matters a so-called septin which he believed was the cause of fever. He found also that the injection of fibrin and cell tissue into the blood produced fever. After the discovery of ptomaines by Brieger and Oeflinger it was hoped that the *materia peccans* had been demonstrated in them. The most different substances were considered to be pyretogenous. Roussy found a ferment in beer that he called pyretogenine. Injected into the blood of a dog, it produced a typical attack of fever. A committee appointed by the Paris Academy of Medicine to investigate this subject confirmed the statement that it always produced high fever, but considered it of dubious chemical purity. Hildebrandt found that the injection of various hydrolytic ferments (pepsin, chymosin, diastase, emulsin, etc.) produced typical fever in dogs and rabbits. After a thorough review of the whole subject Rabe comes to the conclusion that we are at the present time not justified in regarding any chemically pure body as a *causa febrilis*. Whether such a matter may be found as a result of the studies with the serum of the blood by Behring, Klemperer, and others, or by the studies with the toxic albuminoids by Brieger, remains to be seen (Rabe).

The view that it was necessary to combat fever was based upon the doctrine *contraria contrariis opponenda*, which, like every theory based upon a dogma, is false. Still more ancient is the so-called teleological view that the fever itself was curative. Rufus, of Ephesus, A. D. 158, considered fever a cure. He went so far as to wish that he might produce it artificially. Many modern authorities favour this view with the citation of an old axiom, "purified by fire." Sydenham believed that fever destroyed certain injurious substances in the body. This view has met with renewed advocacy in more recent times by Leyden, Finkler, Welch, and Cohnheim, and has been advocated in the extreme by Unverricht. From Boerhaave most modern authorities take opposite views. Liebermeister went so far as to say that to control the fever was to control the situation. Where the agent which controls the fever destroys the cause, this view is true. Thus quinine controls the fever and destroys the cause of malarial disease, mercury has the same effect in syphilis, and the salicylates, especially if the action is sustained, have it in rheumatism. These agents are antipyretics because they are antimycotics. Thus alcohol is often an excellent antipyretic in sepsis, and large doses of cognac will often prevent or postpone an attack of hectic.

The thermal death-points of the organisms that cause the various infectious diseases have been accurately determined, and the view that the temperature of fever may destroy the life of bacteria is not supported by direct observation. Bacteria which do not contain spores are killed in fluids only at a temperature of from 131° to 136·4° F. Spores, however, survive such temperature, and perish only at the boiling point. But bacteria outside the body may be hindered in their development at lower temperatures. Thus, according to Koch, the tubercle bacillus thrives best at from 98·6° to 100·4°, badly at 84°, and not at all at 102·2°. Numerous observations show that at a temperature of 107·6°, maintained for three weeks, no growth occurs. According to Gaffky, growth and spore-formation occur in typhoid fever even at a temperature of 107·6°, though less vigorously, as a body temperature of from 84° to 104° appears the most suitable for the formation of spores. In this temperature spores develop in the course of from three to four days. This development still occurs at 77°, but is slower; the lowest limit seems to be at 68°. In other cases high temperatures do not stop development, but attenuate, lessen, and reduce the virulence of bacteria.

The degree of temperature necessary to destroy bacteria is so high as to be incompatible with the life of man. The question cannot, therefore, be pursued in this direction, but a temperature of 107·6°, which checks the growth of the tubercle bacilli, and that of 108·5°, which robs anthrax bacilli of their virulence, constitute the maximum limits of fever temperature. This degree is reached with regularity only in the course of relapsing fever. The question as to the degree of temperature which is fatal to bacteria has great practical importance. A temperature under 111·2°, which the heart of man will endure, is not fatal to bacteria, but it may exert a direct influence upon their virulence and growth.

But fever may be overcome, and the whole disease, of which fever is but a single sign, may be dissipated without at all affecting the vitality of the micro-organisms which produce the disease. This happy result is secured in the process of "immunizing" the blood and the whole body, either by products of the micro-organisms (toxines) or by antagonistic matters which they develop (antitoxines). Tuberculin, which in very small dose (one one-hundredth of one per cent.) produces hyperæmia and coagulation necrosis about the tubercle bacilli, without destroying them, is an illustration of the first class, and the antitoxine of diphtheria, which "immunizes" the tissues and protects them against the virulence of the toxines of the diphtheria bacillus without destroying them, is an illustration of the second class. Vaccination is the use of an antitoxine of even greater power.

These are the antipyretics which address the cause of disease and which, when we possess them in purity, in all cases will render the rest superfluous. Meanwhile, however, resort must be had to remedies which relieve symptoms and restrain excessive actions.

The method of combating fever by antipyretics began with the systematic use of cold water by Currie, in the second decade of the present century, and attracted general attention with the publication of the prize essay by Hufeland on the external use of cold water in the treatment of fevers. But attention was soon diverted from fevers by the employment

of hydrotherapy, especially by Priessnitz, in so many other diseases. From the recommendation of it as a cure for pretty nearly all chronic diseases, it soon fell into disuse in the treatment of fevers. The cold-water treatment was rescued from this oblivion only after forty years, when it was put upon a new basis by Brand in the treatment of typhoid fever. The good results reported by this observer led subsequently to the systematic use of it in other infections, especially by the German clinicians.

The substitution of drugs for baths came at a much later period, although agents had long been employed (veratrum, aconite, antimony) to reduce fever by depressing the action of the heart; venesection, which acted in the same way, had even a more ancient origin and for centuries far more general use.

The treatment of fever by the modern antipyretics was introduced with the recognition of the action of large doses of quinine, but came into general use only with the discovery of the virtues of acetanilide, antipyrine, and phenacetine.

To what extent antipyresis is necessary and useful may be established only in individual diseases. It is well known that a temperature of 107·6° in relapsing fever may continue for a long time without injury, also that reduction by kairine or any other antipyretic has no demonstrable effect upon spirilla. On the other hand, it is known of typhoid fever that the long duration of the fever makes antipyresis necessary, and that by proper use of it a former mortality of from fifteen to twenty per cent. has been brought down to five per cent. and less.

In the acute infectious diseases recovery is possible from the highest fever under purely expectant procedures. Thus, from typhus fever seventy-five to eighty per cent. of the patients recover without any treatment. The same thing is true also in typhoid fever. In yellow fever about sixty-five per cent. recover, even in the worst epidemics, and even from the plague from fifty to sixty per cent. recover. In the course of the disease itself the cause of the infection is rendered innocuous. The disease which shows the highest temperature—to wit: recurrent fever, from 107·6° to 108·7°, lasting sometimes for five to seven days continuously—furnishes a percentage of recovery of from ninety-two to ninety-eight, a ratio not to be compared with that of any similar disease. It is thus seen that a continuous high fever is followed by a spontaneous cure in at least fifty per cent. and up to eighty per cent. of cases, and that the disease marked by the highest fever has a recovery ratio of ninety-eight per cent. (Lewin).

It may be repeated that temperature is no absolute criterion of the severity of the disease. For instance, in typhoid fever grave cases often run their course with low temperatures, and a mild course is not inconsistent with continuous high temperatures. Antipyretics in these cases reduce the fever, but in no way lessen the mortality or even the duration of the disease. There is no doubt, however, of the benefit of antipyretics with reference to the comfort of the patients. The reduction of fever relieves the discomfort, which frequently amounts to actual suffering, and often secures refreshing sleep. It should be known also that fever alone does not necessarily produce discomfort and suffering. It does not necessarily produce anorexia. Thus, in aseptic fever the appetite may remain excellent, sometimes even ravenous. The temperature may remain at 104° for fourteen days without any marked reduction of weight or strength. In fact, the feeling of illness so characteristic of other fevers may be absent entirely, and aseptic fever may be characterized by the most perfect euphoria. The patient, even with a temperature of from 104° to 105·8°, may be capable of great effort. He may walk from half a mile to a mile.

It is notorious also of tuberculosis that the amount of prostration by no means corresponds to the height of the fever, as even pronounced hectics are capable of astonishing effort. The benefit derived from the proper use of antipyretics does not consist merely in the reduction of temperature; it is largely due to the associated action upon the nervous system. The modern antipyretics are also analgetics and anodynes.

It is useless to speculate upon the mode of action of the antipyretics until at least something definite is known of the nature of fever. Increased heat may depend upon increased production or diminished radiation. These factors are largely under the control of the nervous system. That antipyretics act upon the nervous system is shown by their distinct influence in lessening pain and diminishing excitement. Fever is only one effect of a cause which also poisons the blood. Antipyretics as such address themselves to only this one effect; they are therefore in no sense specifics.

There is at the present time much choice of remedies. At the head of all antipyretics is, and remains the *cold bath*, which is discussed in detail elsewhere. The body is cooled by immersion in a cold bath exactly as a hot brick is cooled, but the cold bath has the eminent advantage that it at the same time stimulates and invigorates the heart. The toxines which produce the fevers, especially the fevers of infectious disease, poison the muscular substance of the heart. It is far more important to support the heart, if possible, by neutralizing the toxines than to reduce the temperature. At the present time it is not possible in many cases to destroy the micro-organisms or neutralize the toxines, and good practice in cases of these fevers must consist in the stimulation of the heart and the support of the body. Though they do not control the disease, antipyretics are, nevertheless, of value in relieving discomfort, allaying excitement, and securing sleep. Remedies which relieve fever by merely lowering the action of the heart are worse than useless. Thus, venesection is not worth consideration. For the same reason, veratrum, antimony, and aconite have long been abandoned. They only add to the danger of the disease. The use of these drugs in any of the

infectious fevers is malpractice. Thus mere rest of the heart may prove a valuable antipyretic; the high fever of tuberculosis subsides in the rest-cures of the sanatoria. [See also the articles on ACETANILIDE, ANTIPYRINE, BATHS, GUAIACOL, PHENACETINE, PHENOCOLL, and THALLINE.]—JAMES T. WHITTAKER.

ANTIPYRINE, *phenazonum* (Br. Ph.), *antipyrinum* (Ger. Ph.).—The attempt to find substitutes for quinine led to the discovery of antipyrine. Knorr found it in a base which contains oxygen, a derivative of quinoline. According to the latest investigation, antipyrine is a derivative of pyozol, $C_3H_4N_2$, which is in turn derived from pyrrol.

Antipyrine forms colourless crystals which melt at 535·4°. It is very easily soluble in water, in alcohol, and in chloroform, but soluble with more difficulty in ether. A characteristic reaction is that in very dilute form it strikes a deep blue-red colour with salts of the oxide of iron, while the nitrates colour dilute solutions blue-green and separate from a concentrated solution green crystals which consist of isonitroso-antipyrine.

Antipyrine is easily demonstrated in the urine, into which it passes unchanged, by the test of the chloride of iron, or in the alcoholic or ethereal extract of the urine vapourized to the consistence of a syrup. Antipyrine is detected by the chloride-of-iron reaction in dilution as extreme as 1 to 100,000.

Antipyrine may be absorbed from the rectum as well as from the mouth. It is also taken up by the subcutaneous connective tissue, but subcutaneous injections are not to be recommended, as they cause intense pain and sometimes violent inflammation. The dose necessary as an *antipyretic* must amount to from 5 to 15 grains, to be given every two to three or four to six hours. Small doses of 5 grains are usually sufficient. The temperature falls after a dose of from 15 to 30 grains in from half an hour to an hour, and the fall may amount to four degrees. It may fall below the normal. The maximum effect is reached in from four to five hours. The temperature then remains down for a varying period, from four to twenty-four hours, and then renews itself slowly and mostly without chill.

The maximum doses for children are:

6 months to 1 year of age	3	grains,
1 year " 3 years " "	4·5	"
4 years " 5 " " "	from 4·5 to 6	"
6 " " 8 " " "	" 7·75 " 9	"
10 " " 12 " " "	" 9 " 10·5	"

Antipyrine reduces temperature not by diaphoresis, which is usually insignificant, but by its effect upon the heat-regulating apparatus in the nervous system. This action shows itself in health as well as in disease.

It is best given dissolved in wine, water, or peppermint water.

The reduction of temperature in fevers begins, as stated, in the course of from half an hour to an hour, and the maximum reduction is reached in from three to five hours. The degree of reduction will depend upon the dose, the disease, and other circumstances. The temperature may sink from one to five or more degrees, sometimes to subnormal grades.

The reduction of temperature is attended with increase in the secretion of sweat, which is manifest, as a rule, first about the neck, afterwards upon the chest and face; the sweating is sometimes excessive and may be attended with chilly sensations. Any excessive action in this direction may be combated by the use of stimulation, or may be prevented by the administration of agaricin or atropine. In any case where there is reason to fear prostration the depressing action of antipyrine may be prevented by the use of stimulants.

The pulse is reduced, but not in the same ratio. It sometimes remains unaffected. The blood-pressure is usually increased with the fall of temperature, but is sometimes reduced on account of dilatation of the peripheral vessels. The action of the heart is correspondingly reduced in frequency, and is thereby sometimes increased in tone, but, as a rule, the force of the systole is lessened, at least to some extent, and this is the special evil which attaches to the modern creations of the materia medica. Quinine, which may be said to be a product of Nature, sustains the heart.

The action of antipyrine has been especially studied in *typhoid fever* and *pneumonia.* It exercises its best effect in cases where the heart is most vigorous, therefore especially in the young. There is no doubt of the value of small doses of antipyrine (perhaps preferably phenacetine) in the treatment of typhoid fever in children. This action is shown not only in the reduction of temperature, but especially in quieting the restlessness and general distress caused by the action of the typhoid toxines upon the nervous system. Most practitioners of the present day actually prefer the antipyretics of the materia medica to the action of cold water in the treatment of typhoid fever in childhood. These statements are true also of pneumonia in young children, but they apply in no case to the treatment of typhoid fever, and certainly in no case to the treatment of pneumonia in adult life, where the cold bath is to be preferred because it stimulates the heart and thereby favours the elimination of toxines by the kidneys. Antipyrine is also indicated in any of the febrile infections of childhood—*measles, scarlatina,* etc.

Antipyrine is of great value in the relief of diseases in which nervous symptoms predominate. This is especially the case in *influenza,* in which disease antipyrine was at one time thought to possess specific properties. The discovery of the bacillus of influenza, over which antipyrine had no destructive action, soon disposed of this view. Antipyrine is also of great value in the treatment of *rheumatism,* though it is subordinate in every way to the salicylates.

Antipyrine exercises a favourable effect in some of the purulent affections, especially in cases marked with a tendency to *delirium.* It is often used for the prevention or limitation of the *hectic* of tuberculosis. It exercises, however, no real control over the disease, and is sometimes injurious from its adding to the

general debility by lowering the action of the heart and by increasing sweating.

But the action of antipyrine is not confined to diseases attended by fever. Antipyrine is especially recommended as an *antineuralgic* and *antirrheumatic*. It has a favourable influence on *hemicrania, sciatica, bronchial asthma*, the *fulgurant pains of locomotor ataxia, nervous dysmenorrhœa*, and *chorea*. It has a good effect also in *whooping-cough*, where it is given three or four times a day in doses of 1½ grain for each year of the child's age.

The use of antipyrine is sometimes attended with bad effects; certain persons seem to have a peculiar idiosyncrasy with regard to it, in that it acts with them almost as a poison. Conditions of collapse sometimes supervene. This is especially wont to be the case in organic disease of the brain and heart. More ordinary bad effects are nausea, heartburn, and vomiting; these symptoms show themselves especially in feeble patients. Such injurious effects upon the stomach may for the most part be evaded by administering the drug by the rectum. Sometimes the remedy acts with excess; the temperature is reduced below the normal and the patient is brought into collapse, with chilly sensations and profuse sweating, and a sense of anxiety with vertigo, sometimes with dyspnœa, may supervene. Occasionally cases are marked by stupor, more rarely by coma or convulsions. Sometimes there are conditions of excitation and delirium. In other cases the remedy acts especially on the heart; the pulse becomes feeble, fluttering, and intermittent, and cyanosis may ensue. In phthisical and typhoid patients a tendency to hæmorrhage may develop. The influence upon the vaso-motor system may develop œdema, and œdema of the glottis may lead to attacks of suffocation. Various exanthemata sometimes ensue, such as erythema, urticaria, scarlatiniform and rubelliform eruptions, and, more rarely, petechiæ. These drug eruptions are especially distinguished by itching and burning, more particularly by rapid disappearance in the course of a few hours or days after the cessation of the use of the drug. Rarer toxic symptoms are spots of discoloration about the face, swelling of the lips and tongue or of the salivary glands, discoloration of the mucous membrane of the mouth, tremor, convulsions, epileptoid attacks, amaurosis, ringing in the ears, deafness, and delirium. In still rarer cases there may be observed colic, diarrhœa, albuminuria, hæmaturia, ischuria, or strangury. Infants at the breast have shown toxic symptoms when the drug has been taken by the mother. Interruption of the milk supply sometimes occurs after the use of antipyrine. As antagonists, belladonna and its active principle, atropine, have been specially recommended.

[Antipyrine has been employed by Vigneron, of Marseilles (*Ann. d. mal. génit.-urin.*, May, 1894), as a local anodyne in *cystitis* and in various morbid conditions of the bladder in which topical treatment is required, but is painful. When the bladder is empty, he injects from 3 to 6 fl. drachms of a 4-per-cent. solution, and allows it to remain for about ten minutes, when the therapeutic procedure may be carried out. He thinks it acts also as an antiseptic of about the value of boric acid.]

Antipyrine should never be given in connection with other remedies. Tannates and tinctures containing tannic acid precipitate it from its solution, as do also solutions of chloral, arsenic, mercury, and carbolic acid.

James T. Whittaker.

ANTIRRHEUMATICS are agents or means employed in the treatment of *rheumatism*. There are many varieties of rheumatism, but there is probably the same underlying cause in all. There are many conditions in any given case of rheumatism which must be taken into account in considering the question of treatment. The influence which heredity plays, the habits of life of the patient, his occupation, previous attacks of rheumatism with result and complications, climate, the condition of the digestive system, and his station in life must all be considered. The objects to be attained in *acute articular rheumatism* are the relief of pain, the reduction of fever, the reduction of the articular manifestations, shortening the duration of the attack, relieving the disturbances of the nervous system, and preventing complications, sequelæ, relapses, and recurrences. The question naturally arises whether we have any agents which will accomplish any or all of these objects. In any inflammation a certain amount of relief from pain can be attained by rest, and in acute articular rheumatism the question of rest usually takes care of itself, as the patient generally has too much pain to do otherwise than remain in bed. The pain being in a joint, any method which is adopted that will prevent motion of the joint, even to a moderate extent, will relieve the pain. From time to time various methods have been adopted for the purpose of producing more or less fixation of the joints. The well-known method of wrapping the joint in cotton batting helps to attain this object by preventing pressure and motion. The use of splints, properly applied, prevents movement of the joints more or less. Putting the joints in any position which lessens their motion aids in relieving pain. All sorts of *local applications* have been made for the relief of pain, but have thus far proved to be of little effect. In a small proportion of cases a local application of a solution of *alkalies*, preferably *sodium bicarbonate*, or of *oil of gaultheria* with an equal quantity of olive oil, the joints in either case being wrapped in cotton batting, may give relief. *Blisters* for relieving the pain in acute articular rheumatism have become a thing of the past, and *iodine* locally applied fails to give relief. The superficial firing by means of a *Paquelin cautery* will give relief in some obstinate cases, and flannels wrung out in very *hot water* will sometimes do so. *Ice* also has been applied for the purpose of relieving pain, but without giving satisfactory results.

In the treatment of rheumatism there is no remedy which approaches in efficiency the *salicylic-acid* compounds as to most of the

objects to be attained. While the use of *opium* at the very beginning of an attack is justifiable for the relief of severe pain, before the patient can be brought under the influence of antirrheumatic agents, it has unpleasant effects which make it undesirable to use for any great length of time. The coal-tar preparations, such as *antipyrine*, *acetanilide*, and *phenacetine* and their compounds, will often relieve pain, reduce temperature, and make the patient comfortable for the time being, but they do not seem to have any beneficial effect upon the progress of the rheumatism itself. It has been alleged that they prolong the attack.

The *salicylic-acid* compounds stand pre-eminent among the antirrheumatic agents. The cases in which these agents fail or are only slightly efficient are often cases of atypical rheumatism; there are some cases, however, of true rheumatism in which they are inefficient, and in many cases of hyperpyrexia they fail to reduce the temperature. Their beneficial effects in acute articular rheumatism are shown in the modification or the control of the pyrexia, the diminution and subsidence of the articular manifestations, and the lesser liability to relapses if these agents are properly used. The earlier the patient is brought under the influence of the drug the shorter will be the run of the fever, the less severe will be the joint trouble, and relapses will be more likely to be prevented. If the remedy is given early, in the majority of cases the temperature will be materially modified in from three to five days, the joint symptoms a little later, from five to eight days, and the disease, by a proper use of the remedy, kept under control until convalescence is established. The question of whether these compounds prevent *heart complications* is a mooted one. Theoretically, if they cut short the disease, there should be less likelihood of heart complications. Statistics, however, would seem to show that they fail to lessen materially the relative number of cases in which heart complications occur. The cardiac complications are apt to occur very early, oftentimes before the patient is seen, and it is probable that the salicylates do not in any way control them when once they are developed. What has been called the *full alkaline treatment* does seem, however, if not to prevent, at least to diminish the severity of, the pericardial and endocardial changes. The combination of salicylic acid in some form with the full use of the alkalies is the best treatment for acute articular rheumatism which can be devised at the present day.

Delirium in acute articular rheumatism is a rare occurrence; still, it does occur, sometimes probably as the result of the specific effects of the poison, or it may be due to the hyperpyrexia, or the severe pain itself may be an additional factor in very sensitive nervous organizations; it must be borne in mind, however, in the treatment with the salicylates, that they sometimes produce delirium; also an acute pericarditis may be accompanied by a high temperature and delirium. Occasionally nervous symptoms may be accounted for by the presence of renal disease.

Acute articular rheumatism is a self-limited disease: if, however, the use of the drug is discontinued or the dose greatly reduced as soon as the principal symptoms are modified, the pyrexia with all its accompaniments is apt to return. These salicylates are not always well borne by the patients; they often cause, in varying degrees, nausea, vomiting, tinnitus aurium, headache, skin eruptions, and, in some cases, even after moderate doses, more marked poisonous effects. These are gastric disturbance, severe headache, disturbances of the sight and hearing, delirium, and deep, rapid respiration. By some the salicylates are thought to cause cardiac depression and slowing of the pulse, but these effects on the circulation are, in the majority of instances at least, reflexes accompanying the gastric disturbances. These facts, and the additional one that there is a great difference in the various forms of the drug as to the benefit produced and as to its proneness to cause toxic symptoms, make it a question, in the treatment of rheumatism, of the choice of salicylates.

When *sodium salicylate*, which is the compound most frequently used, produces unpleasant symptoms, there are other salicylates which can be substituted. The *oil of gaultheria* contains 90 per cent. of salicylic acid, and it is one of the very best antirrheumatic agents, ranking next to sodium salicylate in its beneficial action; it has less tendency, also, to cause the symptoms of salicylic-acid poisoning, although it may cause typical toxic symptoms. The salicylic acid made from this oil is a purer product than that usually found in the market, and is less likely to cause disagreeable or toxic symptoms, although a drug has been put forward which, it is alleged, is free from foreign products and in every respect equal to the salicylic acid manufactured from this oil. Of all the newer synthetical salicylates, *salophene* seems to be the most efficient. In some cases it seems to produce better effects than even the sodium salicylate. It has this in its favour, that it is almost tasteless and rarely produces any gastric disturbances. It will not influence large articular effusions to the same extent that sodium salicylate will, and it has very little action as an antipyretic. It has been found to be of marked service in many cases of *subacute gouty arthritis* when other drugs recognised as remedies for gout have failed. The boundary line between gout and rheumatism oftentimes can not be definitely laid down clinically, and the diagnosis is not infrequently decided by the effects of drugs. Some cases which seem to be gouty when judged by the symptoms have yielded to salophene.

Salol and *sodium dithiosalicylate* seem to be valuable in a certain class of cases. To salol there is the objection that, being a compound of carbolic acid, it cannot be given in sufficiently large doses to cause very decided salicylic-acid effects without producing carbolic-acid poisoning. The sulphur in combination with the salicylic acid in sodium dithiosalicylate makes it especially desirable in the subacute forms of rheumatism and gout. Each of these agents has greatly in its

favour the fact that it does not disturb the digestion.

Hydrotherapeutics is found extremely beneficial in many cases of rheumatism and gout. It is more adapted to the subacute and chronic forms than to the acute. *Muscular rheumatism* often yields very readily to *hydrotherapeutics*. *Alkaline* and *sulphur waters* have attained great reputation in the relief of various forms of *gout* and *rheumatism*. They may be used both internally and as baths. It is probable that a great part of the benefit obtained by the use of these agents at the various spas is due to the systematic living and the careful attention paid to diet by the patient when visiting them. Attention to diet and careful habits of living are both of great importance in the treatment of rheumatism and gout under any conditions.

A. Alexander Smith.

ANTIRRHEUMATIN is a trade name for a drug which is said to be a mixture of sodium salicylate and methylene blue introduced by Kamm as a remedy for *rheumatism*. It is in the form of deep-blue crystals, of a slightly bitter taste, soluble in water and in alcohol. It has been given in acute rheumatism, in the form of pills, each containing from 0·046 to 0·092 of a grain, every second or third hour. It gives the urine a blue or greenish tint.

ANTISCORBUTICS are remedies against *scurvy*. Although a theory has been advanced that scurvy is due to a specific micro-organism, the fact that in adults the disease is almost always cured by adding fresh vegetables and fruit to the diet, and in infants by a modification of the milk given, shows that it is due to a nutritional or chemical rather than to a parasitic cause.

Various substances have been recommended for the prevention and cure of scurvy. Among the most prominent are fresh vegetables, fresh fruits, fresh milk, fresh meat, Moselle wine, sugar and molasses, dried mango pulp, alkaline waters, the water dock (*Rumex lapathicus*), the American aloe (*Agave americana*), ergot, acids, ammonium carbonate, quinine, the salts of potassium, horseradish (*Cochlearia armoracia*), and black ants.

Lieutenant Schwatka, who had a medical education, stated that in whaling vessels in the Arctic Ocean scurvy existed because freezing completely destroyed the antiscorbutic properties of lime-juice and of lemon-juice, which are commonly carried on vessels bound on a long voyage, to serve as preventives. He advised that in the case of long voyages dried vegetables, fruits, and meats be substituted for canned goods. Green cucumbers and onions preserved in vinegar prepared from fresh fruit seemed to have an excellent antiscorbutic influence. Molasses also was good. He particularly commended fresh cranberries.

The juice of several fresh lemons, limes, peaches, or oranges, with plenty of fresh milk and raw scraped meat, will suffice to cure scurvy. *Citric acid* has been administered in instances in which fresh fruit was unattainable. Vinegar that is used as a substitute for fruit should be really prepared from fruit, and not made with acetic acid. The administration of drugs is not recommended.

Dr. J. E. Winters states that he has cured *infantile scurvy* due to the use of sterilized milk by simply adding enough fat and sugar of milk to the diluted cow's milk to make up the proper proportion of those ingredients. Many physicians add orange-juice or peach-juice or the juice of raw meat to the infant's diet. These, however, while not harmful, do not seem to be absolutely requisite.

Samuel T. Armstrong.

ANTISEPSIN, or *asepsin*, is *parabromacetanilide*, $C_6H_4Br.NH.(CH_3CO)$. It has been recommended as an antiseptic and stimulant application to *wounds* and ill-conditioned *ulcers*. It has been used internally also to produce the associated action of bromine and acetanilide, but it cannot be recommended for this purpose, as untoward symptoms, such as collapse, have too commonly been observed after its administration.

ANTISEPSINE, according to Soulier, is a compound of iodine trichloride with the lymph or serum that may exude from an abscess after it has been injected with a half-per-cent. solution of the trichloride. Whatever good effect this supposed compound may have upon the diseased tissues among which it is formed, it is obviously unsuitable for any other purpose.

ANTISEPTICS.—[The use of substances capable of preventing or arresting putrefactive processes is treated of in the following sections from the separate points of view of the surgeon, the obstetrician, and the general physician:]

Antiseptics in Surgery.—The antiseptics employed in surgery are agents and methods used to prevent the entrance of living disease germs or their poisonous products into tissues which are under manipulation, and to rid the organism of those already present. These agents and methods are of two general classes —(1) physical and (2) chemical. The physical may be subdivided into (*a*) mechanical and (*b*) thermal. Shaving, scrubbing, and evacuation of abscesses are examples of mechanical antiseptics, while boiling, baking, and the actual cautery are examples of the thermal method. The chemical method consists in the employment of substances poisonous to germs or microbes, but harmless, or nearly so, to the human organism. Proper solutions of corrosive sublimate or of carbolic acid are examples of chemical antiseptics.

The thermal method is the most thorough, but its use is quite limited. The chemical method alone is unpractical and far from certain. The mechanical alone, while not perfect, is to be preferred to any other single method. In an emergency good work may be done and excellent results obtained by the use of a scrubbing brush with soap and water for cleansing the surgeon's hands, his instruments, and the field of operation.

The ideal antiseptic practice, however, is a

combination of all these ways and means, and it will be described farther on.

It is of prime importance in studying this subject to know by what path pathogenic germs may enter, and the first place to occur to one is the field of operation. Then will come the knife with which the wound is made, and the other instruments which may be used; sponges and their substitutes; ligatures and sutures; tubes or other appliances for drainage; dressings of various kinds; the chemicals which may enter the part in washing, irrigating, etc.; the person of the surgeon himself, especially his hands and arms, and his clothing, and, last in importance but still very important, the room and general surroundings of the patient during the operation. It is, however, possible to be antiseptic almost anywhere so long as there is not too much dust in the air.

The treatment of the region of operation and of those things which may infect will be given in the order in which they have been mentioned.

The methods of rendering the various regions and organs of the body free from germs and other filth, though the same in principle, must differ according to the locality involved.

Preparation of the Skin of the Head, Trunk, and Extremities.—Twenty-four hours before the time selected for the operation the patient receives a full bath, unless we have to act in an emergency. The part to be prepared must at this time be thoroughly shaved, whether hair is visible or not. A piece of gauze or similar material soaked in a weak antiseptic solution (1 per cent. of carbolic acid, 0·5 per cent. of lysol, or 1 to 10,000 of corrosive sublimate) is applied as a dressing, and is covered with waterproof protective to convert it into a kind of antiseptic poultice. Just before the operation this dressing is removed and the place scrubbed for three or four minutes—not less—with a stiff brush, green soap (*sapo viridis*), and warm water. The skin is now to be dried with a clean towel and then well wiped with a towel saturated with ether or alcohol. If there are natural folds or depressions present, as at the umbilicus, it is well to pour over them a 10-per-cent. iodoform-ether solution. A thorough sponging with a 1-to-500 corrosive-sublimate solution completes the preparation of the skin. Towels wrung out in a 1-to-1,000 bichloride-of-mercury solution are to be spread over the patient and operating table in such a manner as to leave exposed only the part where the operation is to be performed. If this is near the hand or foot it is best to envelop the fingers or toes completely in an antiseptic towel, and if it is near the face, neck, shoulder, or upper part of the trunk, the hairy part of the head should be covered with an antiseptic towel pinned from the occiput to the brow, so as to form a protecting cap. If the patient has a beard it ought to be covered with an antiseptic towel or, better still, removed by shaving.

Antiseptic Preparations about the Eye.—In working here one must alter the details because of the sensitiveness of the ocular structures, and because the eyelids can not well be shaved. Frequent washings with mild solutions—*e. g.*, a 3-per-cent. boric-acid solution—may precede the operation. The immediate preparation is as follows: First, scrub thoroughly the lids, the brow, and even the conjunctival sac with moist absorbent cotton and *mollin*, which is a bland, very fatty soap. Wash away the mollin with a 1-to-2,000 bichloride solution, then wash away carefully all the bichloride with distilled water or a 3-per-cent. boric-acid solution. Mechanical means are here our main dependence. No powerful antiseptic irritant, such as carbolic acid, ether, iodoform powder, or green soap should be used. All the antiseptic solutions to be used during the operation must be freshly prepared, filtered, and boiled.

Preparation of the Nasal and Oral Cavities.—The nose and mouth cannot be rendered aseptic, but it is our duty nevertheless to cleanse them as well as possible, remembering that if strong solutions are used irritation and increased secretion of mucus will result—conditions favourable to the growth of pathogenic organisms. A mild salt solution or an alkaline antiseptic lotion, such as Seiler recommends, may be injected with a post-nasal syringe to wash away excess of mucus from the nasal cavities. The mouth is best cleaned with a soft toothbrush and a weak corrosive-sublimate or 1-to-2,000 permanganate-of-potassium mouth wash used *very often.* All decaying or foul teeth should be treated by a dentist. The washing of the mouth should be very frequent for at least twenty-four hours before the operation, for the mechanical effect is of the greatest importance. It is an interesting fact not yet fully explained that wounds in the nose and mouth usually heal kindly.

Preparation of the Rectum and Anus.—Here we have really the most difficult problem to solve, but, though we have to deal with a region where germs of many kinds abound and where there is a constant fresh supply of septic material from within, it has been amply proved by the excellent results which the truly scientific surgeon attains that even this part of the body can be cleaned. To begin with, the bowels should be freely moved by a course of laxatives for several days. On the evening before the operation an extra dose should be given—say 1 or 2 teaspoonfuls of compound licorice powder. On the morning of the operation the patient should receive one or more enemata of soapsuds. The skin surrounding the anus and that of the upper part of the thighs must be thoroughly scrubbed and shaved. After stretching the sphincter the rectum is to be well washed with a sponge, on a holder, and green soap, and finally a large sponge to which is fastened a fillet of silk is pushed well up into the rectum to prevent escape of fæces during the operation. Once more washing the rectal pouch with a 1-to-5,000 bichloride-of-mercury solution, we are ready to proceed with the work of the operation. Having finished, it is well to give enough opium to keep the bowels from moving for about forty-eight hours. Where we contemplate performing an extensive operation it is even wise at times to do a pre-

liminary colotomy in order to divert the infecting stream of the fæces for a sufficient number of days to permit of perfect healing of the wound below.

Preparation of the Pelvic Organs in the Female.—In addition to the usual preparations, it is necessary to give frequent hot antiseptic vaginal douches of a weak (1-to-10,000) solution of mercury bichloride, or of a 1-per-cent. solution of lysol, or some other antiseptic of like strength. Just before the operation the vagina must be scrubbed with green soap and a sponge on a holder. If there is the slightest suspicion of inflammation or catarrh of the uterine canal a preliminary curetting should be performed and the interior of the womb well disinfected.

Preparation of the Genito-urinary Passages of the Male.—At least twenty-four hours before the operation the patient should take several doses of oil of wintergreen or some other drug known to retard germ growth in the urine. Even in the minor procedures about the urethra the anterior part of this canal must be well washed out with a solution of permanganate of potassium (1 to 2,000) or an equivalent antiseptic. Glycerin, sterilized, is to be preferred as a lubricant for instruments.

The Abdominal Cavity.—Antiseptic preparations here do not differ from the general ones above mentioned, unless the operation is expected to involve those viscera which contain septic matter, or any other infected cavity actually within the peritonæum. Here indeed we have two fields of operation at the same time—the one where the original incision is made, and also the seat of the trouble within. Infection may originate from either place. Therefore, whenever there is time, we try to prepare the patient by thorough purgation, and even if the case is very urgent there is usually time to wash out the colon and, if there has been foul vomiting, the stomach as well. This latter is a truly antiseptic measure, for it renders the aspiration of irritant and germ-bearing vomited matter into the lungs during anæsthesia less apt to occur.

The Preparation of Instruments.—The cleaning and disinfection of instruments differ somewhat with the materials of which they are constructed. All instruments, when soiled, should first be cleansed by mechanical means to rid them of the larger clots and masses. Those made of metal (except aluminum) or of hard rubber may be quickly and effectively rendered sterile by boiling them for ten minutes or longer in a solution of washing soda, a tablespoonful to the quart. Instruments constructed of hard rubber which has been bent may lose their shape by boiling. Pessaries, for example, are apt to be spoiled by boiling, while knife handles and similarly shaped instruments are not harmed. Most aluminum instruments are ruined by this soda-boiling, but they may be even more quickly cleansed by holding them in a flame until they are heated so that they hiss when put into water. Platinum instruments may, of course, be heated red hot. They are particularly useful in operations about the eye, because the great heat burns off any particles of lint or dust which may adhere even after the boiling. No syringe working with a leather piston and lubricated with oil can be rendered strictly aseptic, but, nevertheless, with good care and the use of strong antiseptic solutions, the common hypodermic syringe may be made reasonably clean. The needles, of course, may be sterilized by heat, and a little plug of absorbent cotton put into the proximal end before affixing it to the barrel will filter the solution as it is injected. In important aseptic cases where injections of cocaine or other non-antiseptic solutions are to be made, the piston syringe might be sterilized by dry heat, or a Koch aseptic instrument, the barrel and needle of which can be boiled, may be employed.

Any vessel large enough to contain the instruments covered by the solution may be used for sterilization by boiling. For convenience, a vessel with a tray like a fish or asparagus cooker may be used. Various modifications of this device are in use in the different sterilizers for sale by the instrument-makers.

Soft instruments, such as catheters and bougies, may be boiled if made of rubber. The woven and varnished varieties, of silk or linen, will not usually stand this treatment, but may be thoroughly cleansed by washing them out with hot water immediately after using, washing the outside with soap and water, and steaming the inside with 5-per-cent. carbolic-acid steam. An apparatus for this purpose has been devised, but the little steam tobacco-pipe cleaners to be had of tobacconists for a few cents will accomplish the same purpose.

Sponges and their Substitutes.—Nothing has satisfactorily taken the place of the sponge in surgery. It is unfortunate, however, that this substance is very difficult to render thoroughly and reliably sterile. It will not stand high heat without losing its soft, absorbent quality. Various ways of preparing sponge exist. The following method has given general satisfaction for many years in private and in hospital practice: Each "raw" sponge is first beaten and roughly washed to rid it of larger particles of sand and lime. The sponges are then soaked in dilute commercial hydrochloric acid to rid them by chemical solution of the remaining lime particles. After rinsing out the acid in plain water, the sponges are allowed to soak in a warm place, so that microbic spores may germinate. This consumes from twenty-four to forty-eight hours. Growing microbes are much easier killed than their spores are. Each sponge must now be thoroughly washed by hand in green soap and water, and when the soap has all been removed by rinsing in fresh water they are put into jars filled with 5-per-cent. carbolic-acid solution and kept until ready for use. They are reliable after twenty-four hours.

Instead of sponges, wads of absorbent sterile cotton or pads of aseptic gauze may be used. Little bundles of the worsted known as Berlin wool, covered with gauze which is sewed into place, make very fair substitutes for sponge. They are elastic as well as absorbent. Sponges and their substitutes had best be used but once, being thrown away after each operation.

Suture and Ligature Material.—Many and varied substances come under this heading.

They are in two general classes, absorbable and non-absorbable. Catgut and the tendons of different animals are of the absorbable class. Silver wire, silkworm gut, silk, and cotton are non-absorbable or nearly so. Catgut is the most generally useful suture and ligature material known. With proper care it can be rendered sterile. There are at least twenty different more or less effective methods of accomplishing the desired result. Two reliable methods will be described, one "wet," the other "dry."

The "Wet" Method.—Take the unprepared commercial gut and shake it well in ether. Allow it to remain for an hour in this fluid, shake again and pour off, changing it for fresh ether in which is dissolved corrosive sublimate in the strength of 1 to 1,000. Wash thoroughly in this ether and then change it for strong alcohol with bichloride dissolved in it, 1 to 1,000. The gut is rendered perfectly sterile and will remain so as long as it is covered by the solution.

The "dry" method of catgut sterilization consists in removing all moisture by immersing in absolute alcohol for twenty-four hours, then heating in an oven or dry sterilizer to 176° F. for an hour to evaporate the alcohol. The gut is then put into the permanent container (box, bottle, or tube) and, after sealing, this with its contents is subjected for two hours to a temperature of 284° F. in a sterilizer. As long as the catgut is untouched and in its germ-proof container it will remain absolutely sterile. If any has been used, the remainder must be resterilized or thrown away.

Non-absorbable material may be sterilized by boiling in a 5-per-cent. watery carbolic-acid solution for ten minutes. Of course, the metal suture may be boiled with the instruments in soda solution. Silk and cotton will not, however, stand this treatment.

Drainage-tubes of rubber, metal, glass, etc., may be made aseptic by the usual boiling in a 1-per-cent. soda or a 5-per-cent. carbolic-acid solution.

Dressings are of many materials. Cotton, wool, and various cotton fabrics, such as cheese-cloth, lint, gauze, etc., sawdust, moss, pine needles, earth, shavings, "excelsior," tow, and an endless list of other substances have been used and recommended. The ideal dressings must be absorbent and surgically clean. Cotton fabrics not in themselves absorbent may be rendered so by boiling in a 5-per-cent. washing-soda solution to dissolve the fat. All the soda must then be rinsed out, and the gauze thoroughly dried, then folded or rolled. It is best rendered aseptic by the thermal method. Steaming for an hour in one or other of the apparatuses for sale by the instrument-makers will do the work. The ordinary Arnold cooker is sufficient for this purpose.

Gutta-percha tissue or protective must be cleansed with soap and cold water and then soaked for twenty-four hours in a 0·1-per-cent. bichloride-of-mercury solution.

Solutions used during the operation must be made with water which contains no dirt or foreign specks. It may be distilled or boiled and filtered, and everything must be freshly prepared so that no decomposition of chemical material may occur. The chemicals of most value to the surgeon are, briefly, bichloride and biniodide of mercury, phenol, iodoform, lysol, tricresol, salicylic acid, etc. The reader is referred to the articles on these various substances for their properties.

The Personal Cleanliness of the Operator and his Assistants.—Coats should be removed and shirt sleeves rolled up above the elbows. A long coat or gown with half sleeves must now be donned. These coats or gowns must be made sterile by heat. Long hair should be covered by an aseptic cap. Hands and arms are now vigorously scrubbed with a sterile brush, green soap, and water for three minutes, special attention being paid to the nails and their immediate neighbourhood. A nail-cleaner and scissors are used to trim the nails and clean the spaces beneath. The hands, after a rinsing in water, are immersed for a moment in strong alcohol to remove the last vestiges of soap, and are then scrubbed well in a dish containing a 0·1-per-cent. solution of corrosive sublimate. This dish had best be of such a size and shape that the hands and the arms up to the elbows can be immersed. If the hands have been contaminated by any particularly virulent filth, it is well after the above-described disinfection to immerse them in a saturated solution of permanganate of potassium till they are mahogany-brown, and then bleach in a strong oxalic-acid watery solution, which must in turn be washed away in the corrosive-sublimate dish. After disinfection, it is needless to say, *nothing* should touch the hands and arms of the surgeon except the part he is operating on and the disinfected instruments used. The hands and arms should not be dried with a towel.

These rules and precautions are to be observed by the assistants, one and all, with the same scrupulousness, and each assistant ought to feel a direct personal responsibility if infection occurs. It is, therefore, quite proper for any assistant or even for a spectator to warn the operator of any breach of aseptic discipline. No one who is regularly attending cases of erysipelas, scarlet fever, or diphtheria should assist or even be present at an operation.

The Operating-room is a subject which may be divided into two heads according to whether the operation is to be performed in a hospital or at the patient's home. This room in a well-appointed institution must be well lighted, both by the sun and by artificial means. Its walls and floor must be smooth and covered with glazed waterproof paint, enamel, or other similar material, so that it may, if necessary, be scrubbed out like a glass vessel. There should be little and only strictly useful furniture, and this, too, should be made of enamelled metal, glass, or other strong and easily disinfected material. The instrument-case should be of iron framework with walls and shelves of glass so fitted together as to be as dust-proof as a safe.

The operating-table must be strong and as simple as is consistent with mechanism for raising or lowering the head or foot. Other things being equal, a glass-topped table is to

be preferred. Hot and cold running water in abundance must be at hand. Last, but far from least, the room should be in charge of a man who is strong, intelligent, and thoroughly clean in theory and in practice.

In operating at the patient's home, although it is impossible to reproduce the surroundings of a hospital operating-room, a careful surgeon can do good antiseptic work. It is not advisable to take up carpets, to do any sweeping or dusting, or to remove hangings. Everything which may cause a dust-bearing atmosphere should be avoided. Choose a good, light room and direct the family to prepare the following articles: One full-sized kitchen table, a smaller table (for instruments), a china quart pitcher, six clean quart bottles without corks, three china wash-bowls or basins, plenty of boiled water, plenty of clean towels (the number will vary according to the operation), a quilt or blanket for the operating- (kitchen) table, a pillow case stuffed loosely with "excelsior," a rubber or oilcloth sheet, two clean sheets, and something to cover the floor to prevent soiling. The surgeon had best bring with him all the other necessary things—pans, solutions, sponges, etc. The operating-table is prepared by covering it with the quilt or blanket. Over this place the waterproof oilcloth or rubber, and upon this spread a clean sheet. It is well to have another blanket for covering the patient to prevent chilling. After disposing the furniture according to the best advantage for the needs of the operation, cover every doubtfully aseptic piece, chairs, little table, etc., with clean towels so as not to leave the undisinfected wood exposed. Everything once in readiness, the operation may proceed with as much certainty of success as one can attain. "Bad workmen always complain of their tools." A surgeon who is thoroughly imbued with the true spirit of antisepsis can work well anywhere.

The Operation.—There are certain points in the pure technique of an operation which are as much *antiseptic* as the preliminary scrubbing. One should by preference cut, not tear, the tissues, for tearing is followed by more or less necrosis of the soft parts, and microbes attack dead tissue by preference. Attend carefully to the hæmostasis, for blood clot is a favourite pabulum for bacteria. Make the incision ample, so as to work by sight, not by touch alone. In the dark a pus pocket may unwittingly be ruptured, and an unsuspected infection will occur and spoil all. Where possible, it is often wiser to dissect out the entire abscess still in its enveloping walls without rupturing it. Primary union is then possible. Use few instruments and have few assistants. Every hand and every instrument introduces a new element or chance for infection. Do not neglect *time* as an element. *Cæteris paribus*, the longer the wound is exposed to the air the more probable is infection.

If the case is a clean or aseptic one, use no chemical antiseptic, but only normal salt solution. This is particularly important in working upon the brain or its coverings and in the peritoneal cavity. If the case is infected, it is well to use irrigation with an antiseptic for the mechanical as well as for the chemical effect. The tried and ancient surgical rules to evacuate pus, and to avail ourselves of the force of gravity by letting wounds drain from the bottom, are just as truly antiseptic as is the boiling of the instruments or the sterilization of the dressings. Wounds known to be clean may be closed without drainage. Wounds known to be infected must be drained. Between these two extremes are many grades, each case having to be judged on its own merits and by the experience of the surgeon.

In wounds involving the peritonæum our technique differs slightly, but the differences depend on the principle of isolating one portion of this great membrane from its general extent, thus in cases of infection restricting the poison to this one small portion. This can be accomplished by "walling off" with gauze packings, put in preferably before the infectious material is evacuated. The reason that this apparently slipshod method is truly valuable depends on the great rapidity with which adhesions form between layers of peritonæum. They are quite firm in six hours and very firm in twenty-four hours. [For irrigation of the peritonæum see the article on IRRIGATION.]

After the operation the danger of microbic intoxication is not passed. There may be infection of the wound from within—from the very blood of the patient. It is therefore right, before operating on one known to have a constitutional disease, syphilis, for example, to institute the proper systemic treatment. The next danger is at the dressings, particularly the first dressing. As much care should here be taken in personal and other disinfection as if it were another operation. A patient had undergone the operation of trephining for epilepsy. Until the fourth day there was no evil symptom. His wound was then redressed and a probe was used in exploration. There was an immediate rise of temperature, and three days later the man was dead of meningitis.

To succeed as a modern surgeon is impossible without the conscientious observance of the rules of antisepsis.

ARPAD G. GERSTER.
HOWARD LILIENTHAL.

Antiseptics in Obstetrics.—The antiseptic requirements of childbed are essentially the same as those of general surgical practice. They concern the obstetrician, the nurse, the patient, and the instruments, utensils, and other special appliances of the lying-in room that may be brought in contact with the field of the obstetric wounds.

The obstetrician, before the first internal examination, prepares his hands and forearms precisely as the surgeon does for an operation. The disinfection must be repeated before each subsequent contact with the genitals of the patient, if in the mean time the hands have touched anything that could reinfect. The usual method of hand disinfection is that of Fürbringer. The permanganate method is to be recommended as still more effectual.

In hospital practice at least it is well for the obstetrician during attendance on a labour case to wear a linen or muslin gown, or an apron

large enough to prevent contact of his hands with his clothing. This garment should be freshly washed and ironed, or, still better, steamed for an hour immediately before use.

It is not necessary that the obstetric practitioner should refrain from attendance on patients with contagious diseases, or from contact with post-mortem material, pus, or other recognised sources of wound infection. After all such exposures the faithful use of proper measures for disinfection, with, if need be, a change of clothing, should secure complete immunity from the danger of carrying infection to his patient. But the antisepsis must be rigorously carried out.

Practically all septic infection in childbed is by contact, and when, in an emergency, the physician has any misgivings as to the asepsis of his hands it is possible in most ordinary labours to manage the birth entirely without direct contact with the field of the obstetric wounds. Internal examinations in simple cases may be dispensed with, and such manipulations as may be necessary during the birth of the fœtal head may be conducted through the intervention of a fresh towel well wet with the antiseptic solution. In all cases internal manipulations should be minimized as much as is consistent with the proper management of the labour. If the hands are well wet with the antiseptic solution no other lubricant is usually required. If vaseline or glycerin is used for the purpose, it can readily be made sterile by heating. The nurse must be as careful in the observance of all antiseptic details as the doctor is required to be.

The patient ought, if possible, to have a full bath and a change of clothing at the beginning of labour. Habits of special cleanliness, with particular attention to the toilet of the external genitals during at least the last week of pregnancy, would conduce to the asepsis of the lying-in period. At the onset of labour, after a proper antiseptic cleansing of the abdomen, the inner surfaces of the thighs, and the pudendum, an antiseptic dressing may be worn over the vulva during the remainder of the first stage of labour. Some non-irritating antiseptic, like Thiersch's solution, should be chosen. Sea sponges are best replaced with cheese-cloth *serviettes* for obstetric use.

There is some difference of opinion among obstetric authorities with reference to the use of the prophylactic vaginal douche. The writer believes that vaginal douching should not be practised during labour except for cause. In morbid conditions of the vaginal secretions it must not be omitted. In such cases its use is demanded not only as a means of preventing infection of the obstetric wounds, but, if the discharges are gonorrhœal in character, as a prophylactic against ophthalmia in the child. A ready means of testing the vaginal secretions is the litmus reaction. In health they are acid to the litmus test. In pathological conditions of the secretions the reaction is alkaline, neutral, or very faintly acid. When, therefore, the litmus reaction is not distinctly acid the vagina and cervical canal should be subjected to a thorough disinfection before the beginning of the second stage of labour. A proper cleansing requires the use of soap and warm water with prolonged and gentle friction with the fingers and the subsequent use of the antiseptic solution. These measures are duties of the nurse. The mercurial salts, if used at all for douching the passages, must be employed with caution and should be promptly washed out, after the disinfection is complete, with an injection of plain sterilized water. This precaution is required to prevent mercurial poisoning. Mercury has been found in the stools after a single vaginal injection. In nephritic and in very anæmic subjects the mercurial antiseptics are positively contraindicated. In prolonged labours with morbid vaginal secretions the disinfection must be repeated at intervals of two or three hours.

The bed and bed linen must be surgically clean. During the second and third stages of labour the material placed under the patient for absorbing the discharges may be freshly washed and ironed sheets, each folded to four thicknesses. An excellent substitute for these draw-sheets is a labour-pad specially made for the purpose. This consists of absorbent cotton, prepared jute, or an equally good absorbent material enveloped in a cheese-cloth sack. A good size is 2½ to 3 feet square and about 4 inches thick. It is sterilized by steaming immediately before use.

Instruments, utensils, dressings, and the like are best disinfected by heat. Three means are available—dry heat, boiling, and steaming.

Dry heat, by exposure in an oven, or by the use of special apparatus, is well adapted to the disinfection of instruments and utensils that will not be injured thereby. It is necessary that the temperature should be at least 234° F. The exposure must be maintained for at least fifteen minutes. For cutting instruments this method is open to the objection that the cutting edges are injured. The temper of steel instruments is not impaired so long as the temperature is kept well below 400° F.

Boiling in water is a convenient means of sterilizing. It is especially applicable to dressings, cheese-cloth *serviettes*, and similar materials, and is equally effective for instruments and other appliances that can conveniently be so treated without harm. The addition of from 1 to 1·5 per cent. of chemically pure washing soda to the water facilitates the removal of greasy matter and prevents polished steel surfaces from rusting.

Steaming is best practised at the atmospheric pressure or but little above it. Moist steam is more effectual than dry, superheated steam; flowing steam is more active than stationary. Any apparatus with which these requirements can be met is suitable. A simple and economical appliance for the purpose is an Arnold steam sterilizer. The materials to be sterilized are more conveniently handled if contained in a wire basket of a size to be received in the steam-chamber. This facilitates removing them promptly when they are ready to be taken out. If allowed to remain in the sterilizer for even a few minutes after the steam-chamber is opened, they become wet

with condensed steam, and polished steel instruments are liable to be tarnished.

Cleanliness of the bed, the bedding, the room, and all the surroundings of the patient is important as essential to the cleanly conduct of the case. The occurrence of atmospheric infection, however, from infected surroundings is, at least, extremely improbable. Sewer-gas and bad air from whatever source are to be avoided, but they are not to be regarded as having any direct relation to the causation of childbed fever, except in so far as such agents may act to lower the resisting powers of the patient.

During the puerperal period absolute cleanliness of the patient's person, of her linen, and of her bed-linen is imperative. The vulvar dressings should be renewed as often as they are much soiled (for the first two or three days every three to six hours), and always frequently enough to prevent the slightest putrefactive odour of the lochial discharges. The external genitals are to be cleansed and washed with an antiseptic solution at each change of the lochial guard.

No vaginal douches are to be used except for cause. In the presence of fetid discharges not corrected by a strict external cleanliness, the vagina may be douched with a 1-to-10 solution of liquor sodæ chlorinatæ, with hydrogen peroxide, or with some other non-toxic antiseptic.

For the vulvar dressing a napkin, freshly washed and ironed or previously sterilized, may be used, or special guards may be made for the purpose. The latter are prepared of absorbent cotton, cotton waste, prepared jute, or similar absorbent material enveloped in cheese-cloth. They should be 2 inches thick, 4 inches wide, and about 10 inches long. A strip of cheese-cloth at each end, about 10 inches in length, serves for pinning them to the abdominal binder. They are to be sterilized by steam before and burned after being used.

Charles Jewett.

Antiseptics, the Internal Use of.—The discovery that putrefactive and suppurative processes were invariably associated with the growth of micro-organisms naturally aroused the desire of physicians to find means whereby these micro-organisms could be destroyed and the putrefaction stopped. The main obstacle to be overcome was the injurious effects of many antiseptics, not only upon the micro-organisms, but also upon their host. The result of much investigation and experiment has been to provide us with a class of drugs which, locally applied and in proper strength, are antagonistic or destructive to the micro-organisms recognised as the cause of local infection, and are at the same time safe for the patient. And thus of so-called surgical antiseptics we have many of great efficiency.

To meet similar infectious conditions when occurring within the body has been as eagerly desired, and this desire is constantly increasing, as from time to time non-surgical diseases are found to depend upon the presence of specific micro-organisms in some part or parts of the body. The difficulties in the way of the attainment of this object have been and are far greater than those encountered in surgical antisepsis. It is therefore little to be wondered at that the internal antiseptics and internal antisepsis of the present day are not much advanced beyond the point of theory, and, in the opinions of some members of the profession, are hardly likely to advance much further.

The principal obstacles encountered in the employment of antiseptics internally are, first, the difficulty of reaching the micro-organisms with the drug without the previous occurrence of such chemical changes in it as would render it almost or quite inert; and, secondly, the great danger of doing serious damage to the patient by giving the drugs in quantity sufficiently large to reach and injure the micro-organism. It is thus seen that the obstacles to internal antisepsis have indeed been great, for in the employment of antiseptics externally neither of these difficulties is met with. Gastric antisepsis, it is true, is akin to external antisepsis, and for this reason is more advanced and more effective than intestinal and systemic antisepsis. Certain drugs have from time to time appeared and have been heralded as the long-hoped-for intestinal antiseptic, but with few exceptions they have failed to meet the requirements, and their use has been abandoned.

Carbolic acid, naturally, was one of the earliest drugs thus employed, and in *gastric fermentation* it is indeed effective, but beyond this it has no influence whatsoever upon either intestinal or general sepsis. The same may be said of *creosote*, for, though it has been thought to cause benefit in cases of intestinal fermentation, if given in keratin-coated capsules (which, dissolving only in alkaline media, prevent the absorption of the creosote in the stomach), yet experience has shown these views to be untenable, and convinced everybody of the impossibility of disinfecting the intestinal canal by therapeutic doses of creosote.

Bichloride of mercury, too, has been used, but the danger from this drug in all but small (and therefore antiseptically inefficient) doses soon became apparent. *Naphthol* also soon proved of little value.

Thymol, *naphthalene*, and *salicin*, however, seem to be serviceable at times in producing intestinal antisepsis. *Salicylic acid* and the *salicylates* have been used for these purposes, and in *gastric fermentation* they are effective. At times it would appear that they opposed and checked *intestinal fermentation* as well, but whether this is due to their direct action or is the result of the increased flow of bile produced by them, it is impossible to say.

Salol, too, is highly esteemed by some, and since it is split in the small intestines into its components, salicylic acid and carbolic acid, its action may be similar to that already attributed to the salicylates. *Boric acid* thus used appears valuable only as a gastric antiseptic. *Resorcin* is highly esteemed by many, and, when given in keratin-coated pills, is thought to act vigorously as an intestinal antiseptic. This opinion is, however, open to considerable doubt.

Benzoic acid and its salts, especially β-naphthol benzoate (see BENZONAPHTHOL), seem about as active as intestinal antiseptics as any drugs we possess, and, while it is difficult to prove the statement made by some that under their uses the number of intestinal micro-organism grows less, it is certainly true that their employment is associated with a diminished amount of indican contained in the urine, and this is assuredly to be regarded as evidence of diminished intestinal putrefaction. Benzoic acid and its salts have been supposed to act as general and systemic antiseptics or antizymotics in general septic and infectious diseases (see BENZOIC ACID), and, although many doubt this efficiency, their use for this purpose has many advocates, and in some cases certainly does seem of value. This statement can not safely be made of any other drug.

HENRY A. GRIFFIN.

ANTISEPTOL, or *cinchonine iodosulphate*, is a fine brown powder said to contain 50 per cent. of iodine. It has been recommended as a substitute for iodoform on account of its freedom from odour. It is insoluble in water, but soluble in alcohol and in chloroform.

ANTISPASMIN, said to consist of 1 molecule of a sodium-narceine compound and 3 molecules of sodium salicylate, $C_{23}H_{26}NO_8Na + 3C_6H_4(OH).CO_2Na$, purports to contain 50 per cent. of pure narceine. It is a whitish, somewhat hygroscopic, alkaline powder, readily soluble in water. Rabow (*Therap. Monatsh.*, 1894, p. 217; *Am. Jour. of the Med. Sci.*, Oct., 1894, p. 475) finds that it has in general the medicinal properties of narceine, but is from forty to fifty times as weak. It is hypnotic, analgetic, and antispasmodic. It has been found particularly useful in *whooping-cough* in doses of from $\frac{1}{6}$ to $\frac{1}{2}$ a grain. The dose for adults is stated as from 3 to 7 grains.

ANTISPASMODICS are remedies which act to prevent or relieve *spasmodic muscular contraction*. It is unfortunate that a term of such clear significance should have been so inappropriately applied, for by far the greater number of text-books class as antispasmodics those drugs, usually of feeble action, the sole effect of which as antispasmodics is to diminish the irritability associated with a functionally deranged nervous system and usually described clinically as neurotic or hysterical. Antispasmodics they no doubt are if spasm is a symptom of the "nervousness" for which they are given, but their application is entirely for a depressed nervous system, of which spasm may or may not be a symptom, and in the correction of other spasms they are practically inoperative.

The misapplication of the word is rendered more marked when we remember that there are other drugs which act as antispasmodics in the truest sense, since by their action spasm itself is relieved, not the weak and atonic nervous condition with which spasm may or may not be associated. For every reason, then, it is wiser to reserve the name antispasmodic for those drugs whose action is opposed to spasm as such, applying to the class generally called antispasmodics the title "nervines."

These true antispasmodics are comparatively few in number, though their modes of action are not all the same, some acting especially by reducing the irritability of the nerve centres, while others act upon the terminal fibres of the motor and sensory nerves, and still others by producing anæsthesia. A few, too, act by causing general muscular relaxation. Especially prominent among the true antispasmodics are the general anæsthetics (most powerful of all, but seldom required save in severe cases), the bromides, chloral, nitrite of amyl, nitroglycerin, opium, and belladonna, and, less prominent, but still often of great service and effectiveness, cannabis indica, conium, aconite, tobacco, hyoscyamus, and oil of cajuput. These drugs, then, are truly antispasmodics, and appear to act to a greater or lesser degree in all cases, but each spasmodic condition finds among them one or more whose action in that condition appears of special value. Thus, in *anal spasm* belladonna seems the most effective. In *spasm of the urethra* belladonna is also of value, but opium seems rather more effective. In *spasm of the larynx* the bromides are indicated, or amyl nitrite may be inhaled advantageously. For *vesical spasm* the most valuable drug is belladonna given internally or introduced into the rectum in the form of a suppository. Hyoscyamus and cannabis indica also are excellent in this condition. For *intestinal spasm* opium is the most reliable drug if the attack is violent, but for prophylactic effect in the prevention of griping belladonna ranks first, hyoscyamus being rather less effective, though of much value. In *bronchial spasm*, inhalations of amyl nitrite are at times of service, also the internal administration of belladonna or nitroglycerin. *Spasmodic contraction of the arteries* is best relaxed by nitroglycerin or chloral, the latter being rather the more powerful of the two. For prompt action in this condition there is nothing so effective as inhalations of amyl nitrite. In violent *spasm from irritative lesions of nerve trunks* conium seems the most effective drug, while *spasm due to cerebral irritation* is best treated with a bromide.

The drugs which I think are more properly to be described as nervines include no such active agents as that just considered, for, with few exceptions, these drugs are mild and even powerless to harm. They are slow in their action as well as weak, and, as has been said, are serviceable as correctors of the hysterical condition of which spasm may be a symptom, rather than as relievers of spasm itself. They are mild in action as a rule, and their administration is therefore to be continued for a considerable time. Beyond this soothing and quieting effect upon nerve tissue they have little or no pronounced power, as a class, save a very slight capability of producing circulatory and cerebral stimulation. In health their effect in ordinary doses is usually little or nothing. How it is that they act on nerve tissue is not understood. As a class they are characterized each by possessing a marked odour, and to this class belong asafœtida, galbanum, ammoniac, camphor, valerian and the valerianates, cypripedium, scutellaria, tea, coffee, chocolate,

cocoa, sumbul, guarana, musk, oil of amber, ethereal oil, and compound spirit of ether.

HENRY A. GRIFFIN.

ANTISUDIN is a trade name for powdered alum, from its topical use in *local hyperidrosis*.

ANTISUDORIFICS.—See ANTHIDROTICS.

ANTISUDORIN is a German trade name for a solution of 9 parts of chromic acid in 100 of water, used topically as a corrigent of *local hyperidrosis*.

ANTISYPHILITICS. — See MERCURY, IODINE, POTASSIUM IODIDE, and GOLD. Innumerable vegetable drugs, especially sarsaparilla, are popularly supposed to be curative of syphilis, but their efficacy, save as adjuvants, probably amounts to nothing.

ANTITÆNIA.—Vacchieri's nostrum for the cure of *tapeworm*, thus entitled, is a paste consisting of 50 parts of the powdered seeds of *Cucurbita maxima* and 10 parts each of sugar and glycerin, scented with orange-flower water.

ANTITETANICS.—These remedies are practically identical with the true antispasmodics (see ANTISPASMODICS).

ANTITETRAIZINE is described as a quinine derivative that has been employed by Zambeletti in *influenza*, *rheumatism*, and *neuralgia*, in doses of from 3 to 4 grains every six hours.

ANTITHERMICS.—See ANTIPYRETICS.

ANTITHERMIN, or *phenylhydrazine lævulinate*, was recommended by Nicot in 1887 as an antipyretic, but it is too dangerous a poison for use in therapeutics.

ANTITOXINES. — When a culture of diphtheria bacilli in broth is passed through a Chamberland filter the germless filtrate will be found to hold in solution a powerful poison. This poison, or *toxine*, can be precipitated, and it gives the reaction of an albuminoid substance, but its chemical composition is not exactly known. If normal serum from the blood of an animal is mixed with this toxine the serum will not lessen the virulence. Let the animal, however, be rendered proof against diphtheria, then the serum, if added in a sufficient quantity, will neutralize the toxine, thus proving the existence of a new substance in solution, which is called an *antitoxine*.

George F. Nuttall first demonstrated that the antitoxic virtue in the body of an animal that has been rendered proof against any disease existed in the blood serum. Some "immunizing" serums act by directly neutralizing the toxine, such as the antitetanic and antidiphtheritic serums and those found after "immunization" against abrin (from the jequirity bean), ricinine, and snake venoms; others will not directly neutralize the toxine, but they prevent the formation of toxine by destroying the causal micro-organism itself. The serum of rabbits made refractory to hog-cholera and pneumonia, and of guinea-pigs "immunized" against cholera and the aviar vibrio, are not protectively antagonistic, either *in vitro* or in the animal body, to the toxine of these diseases, but they destroy the bacteria themselves and thus protect. Metschnikoff has proved this for hog-cholera, Issaeff for pneumonia, Pfeiffer for cholera, and Sanarelli for the aviar vibrio and typhoid.

The toxine and antitoxine of tetanus and diphtheria react in the very same manner to reagents, but the chemical composition of the various antitoxines is at present more hidden than even that of the toxines; indeed, there is a number of scientific persons who maintain that antitoxines as such do not really exist. They are of the opinion that the phenomena observed are really effects of a modified toxine instead of a specifically opposed substance like an antitoxine—the toxine is so changed in its passage through the body that it inhibits the action of newly introduced toxine. G. Klemperer, for example (*Deutsche med. Wochensch.*, 1894, p. 435), writes, in explanation of insusceptibility in certain cases of exposure to cholera: "The toxine of the comma bacillus in the intestinal tract is transformed by the action of the nuclein of the epithelium."

The arguments advanced to uphold the modified-toxine theory are: (1) The so-called antitoxine is abundant in animals in an exact ratio to the quantity of toxine injected; (2) the properties of toxines and antitoxines are similar; (3) if the injection of toxines is discontinued, the quantity of supposed antitoxine is lessened till it even disappears in some cases.

Roux and Vaillard have recently refuted these arguments. It is not true (1) that antitoxine is evolved in proportion to the quantity of toxine injected. If, say, 103 c. c. of a toxine is introduced into the circulation of a rabbit in two months in nine doses, and the same quantity is injected in the same time into another rabbit of exactly the same weight but in thirty-three doses, the latter animal will produce six times as much antitoxine as the other. It is true (2) that the chemical reactions of toxines and antitoxines are alike, but in our present utterly uncertain knowledge of their composition we may suppose that both are proteids, and similar reactions are to be expected. (3) The disappearance of antitoxine consequent on the discontinuance of toxine injection can be explained by the lessened cell-stimulation; moreover, the antitoxine, real or supposititious, exists in the blood serum, yet if we draw off by repeated bleedings an amount of blood equal to the entire quantity in the animal's body, the serum removed is still antitoxic, for a time at least, showing that cell-excitation and not mere modification of the toxine in the circulation, is the factor to be reckoned with.

Antitoxines, whether they are merely modified toxines or essentially different substances, exist, and there are frequent additions of late to the arguments which go to prove them to be due to cell-stimulation, as Buchner first suggested. If the neutralization of a toxine by an antitoxine were a simple chemical reaction, identical effects should be produced under like circumstances, but this is not seen. Take two guinea-pigs of equal weight, one of which has never undergone any process of "immunization," and the other of which has

been "immunized" against the vibrio of Massaouah. If we inject 0·5 c.c. of a mixture of 900 parts of tetanus toxine with 1 part of antitetanic serum into each animal, the first remains unharmed, the latter is killed. The same holds good when two such guinea-pigs are tried with diphtheria toxine. The animal which has recovered from a previous inoculation with diphtheria dies despite the injection of protective serum.

We cannot say that in the case of the normal guinea-pig the active cells respond to the stimulation of the toxine and thus produce neutralizing antitoxine, because this antitoxine is already supplied by the injection of the antitetanic or antidiphtheritic serum. It may be that the co-operation of the recipient's own body cells is necessary to obtain the effect of the injected antitoxine, whether the neutralization is performed within the body of the protected animal or supposed to be effected *in vitro* before injection. The toxine and antitoxine may be in unstable union, but they are maintained safely in this composition by the co-operation of the normal cell. Snake venom, when neutralized *in vitro* with an antitoxic serum, grows virulent again if heated to 70° C. (158° F.), showing instability of neutralizing union, if any union really exists. In the case of the animal which dies because of the previous action of the vibrio of Massaouah or of the diphtheria bacillus, the cells, already jaded by overstimulation, or substantially altered, do not co-operate. It is possible also that a third substance, formed in the serum during the previous "immunization," does not permit of the union of tetanic toxine and antitoxine, and that the cell is not a factor. This entire argument is somewhat outside of the question at issue, because the conditions are different from those in which immunity is ordinarily acquired. The immunity given here is immediate, not gradually acquired as when we "immunize" a horse against diphtheria, or when a man acquires tolerance of a drug, if, indeed, in the latter case there is really an upbuilding of an antitoxine in every instance.

Again, we know that rats are naturally proof against anthrax, chickens against tetanus, and white mice against diphtheria, but the serum of these animals will not protect susceptible animals against the diseases mentioned. If immunity were an effect of mere chemism, the serums would protect other animals. There is no antitoxine in the serum of the naturally insusceptible animals. The resistance seems to be in the cells themselves, or perhaps the protective agents are congenital alexines in the cells. This protective faculty in the cell itself is probably not found in the lasting acquired immunity of a susceptible animal observed after attacks of some infectious diseases. Here an actual antitoxine seems to be present in the blood. In a series of experiments made with serum from a number of men who had had typhoid fever at various periods before the time of experimentation. R. Stern protected mice against the bacillus with serum drawn from patients that had had typhoid fever nine years and a half previously, but the serum from a man who had had the disease fifteen years before the experiment did not protect. The cells of naturally insusceptible animals are indifferent to the toxine stimulus; hence it is that when protective serum is to be produced artificially susceptible animals are used, because their cells respond to toxic excitation and produce antitoxine in large quantities.

Another argument against the assertion that neutralization of a toxine is merely a chemical reaction is the fact that the antitoxic serum in tetanus, for example, does not immediately restore the functions of the diseased cells. A chemical reaction should have a more direct result. Furthermore, it is in the cellular yolk of an egg that the antitoxine is found, not in the white.

The antitoxines in preventive serums are not always solely specific in action. Deutschman lately asserted that serum from an animal rendered insusceptible to symptomatic anthrax protected against the bacillus of acute septicæmia. Tetanus antitoxine will not neutralize diphtheria toxine, but it will neutralize cobra venom; the antitoxine of cobra venom, however, will not check tetanus toxine. The antitoxine of rabies will also protect against snake venom up to five times the lethal dose of this venom, at least in rabbits. There is partial neutralization of snake venom by the antitoxine of abrin, and conversely, and a slowing of the fatal action of abrin poison is effected by the antitoxine of diphtheria, according to Roux.

The antitoxines may be nucleins, albuminoids from cell nuclei, as Vaughan suggests. The leucocytes seem to be the most active of the nuclein-bearing cells, and this may have to do with the protective determination of leucocytes towards a spot infected with pathogenic bacteria. What cells, however, are most instrumental in producing antitoxine we do not know—as Roux has said, "The subject is too little advanced at present to be decided." [For the special uses of the individual antitoxines, see the article on SERUM THERAPY.]

AUSTIN O'MALLEY.

ANTIZYMOTICS are: 1. Agents that check fermentation. In therapeutics they are chiefly employed to relieve *dyspepsia* due to gastric or intestinal fermentation (see ANTISEPTICS, subheading *Antiseptics employed internally*). 2. Measures that tend to prevent infection with the so-called zymotic diseases (such as vaccination) or are remedial in the treatment of those diseases.

ANTODONTALGICS.—It should hardly be necessary to state that in the larger proportion of cases of *toothache* permanent relief can be obtained only by employing the services of a dentist, and that this article deals solely with measures that are simply palliative, with sufficient mention of the causes and symptoms to assist in the determination of whether the teeth themselves are at fault or whether the trouble is more deeply seated. Of course, the most common cause of pain in the teeth is *dental caries* in one form or another, which may expose the dentin or pulp to the action of

irritating bodies or set up changes in the pulp that lead to the formation of pus, which reaches the surface at some point on the gums or in some cases, fortunately rare, splits the tooth or expels a filling. Suppuration of this variety, *alveolar abscess*, is popularly known as a gum-boil or ulcerated tooth, according to the amount of swelling of the gum. Often a tooth which has been plugged properly and by an expert is the seat of pain, also those which are much worn down, especially when the person is a free user of tobacco. In these varieties the pain is ordinarily dull in character and is apt to be excited by chewing hard substances or by hot or cold liquids. Sometimes accumulations of tartar along the margins of the gums give rise to a feeling of soreness in the teeth which may deserve the title of pain, but, however, is quickly relieved by the removal of the tartar. Usually the pain in teeth decayed to any considerable extent is acute, easily set up by the action of food or other irritating bodies, and not often very prolonged, provided the exciting cause is removed, while that caused by suppuration is throbbing, is nearly continuous, is accompanied by swelling of the gum, and after reaching a climax of considerable severity is relieved by the discharge of pus. As a rule, swelling of the gum dependent upon dental caries is near the teeth affected, but occasionally it is at a somewhat remote point. It is the general rule that pain is limited to the diseased tooth, but occasionally it happens that the adjoining teeth are involved so that it is not possible for the person to distinguish which one is at fault. If, however, each tooth is touched with a piece of cold metal, the most pain is excited in the carious or affected tooth. In cases in which the pain is felt in an entire lateral half of a jaw it is often difficult to determine whether the teeth are the cause of pain or whether there is not a true neuralgia of the dental nerves. In uterine disease, disordered stomach, etc., a reflex toothache sometimes occurs, but as a rule it is simply a symptom that the dental branches of the fifth nerve happen to be a weak point.

In all cases in which a cavity exists it is of importance that everything in the shape of foreign matter be removed, and this is most easily accomplished by a stream of warm water. This usually aggravates the pain momentarily, but is often all that is necessary for its complete removal. Cotton impregnated with almost any of the *essential oils*, that of *cloves* being most commonly used, *creosote*, *equal parts of chloral hydrate* and *camphor*, *carvacrol*, a 1-per-cent. solution of *atropine sulphate*, *menthol*, or *collodion* and *carbolic acid*, and pressed gently into a cavity, usually breaks up an attack of toothache, but does not remove the liability to its recurrence. *Solutions of cocaine hydrochloride* are sometimes used, but with little advantage, for, while they may relieve the pain, they are very apt to aggravate the conditions upon which it is dependent. There is, however, no objection to applying cocaine to the gum, but if it is used in that manner its effects are very transient and uncertain. *Chloroform* is open to the same objections, and is also very uncertain. When cavities are very large, especially in the deciduous teeth of children, the application of *solid silver nitrate* causes the formation of a tough pellicle of silver albuminate which protects the pulp from the action of irritants and also retards the process of decay somewhat. Probably the most effectual preparation is a mixture of equal parts of *tincture of aconite root* and *tincture of iodine*, to which a small amount of *chloroform* may be added if desired, which is painted over the gum around the aching tooth, and in some cases the tincture of iodine alone is useful. Whenever any puffiness of the gum is noticed an incision should always be made down to the bone and kept open to allow of the free discharge of any pus which may be present. In children, when the deciduous teeth are badly decayed, a small hole should be drilled into the pulp, so that any pus which forms there may not burrow into the surrounding tissues. *Dry heat* or a *poultice* to the face and applications of *aconite* are useful, and in some cases a small *blister* acts well. The propriety of using *narcotics* can hardly be discussed, as the condition of the person must always be the guide for their employment. During an attack it is well to avoid taking sweet or sour substances into the mouth or very hot or cold liquids, but a proper amount of nourishment must be taken.

RUSSELL H. NEVINS.

ANURETICS.—According to Husemann (Geissler and Möller's *Real-Encycl. d. ges. Pharm.*), Rabuteau classes under this name agents that seem to diminish the secretion of urine, including tannic acid and gallic acid.

APARINE.—See GALIUM.

APERIENTS, APERITIVES.—See under CATHARTICS.

APHRODISIACS.—Where remedies are desired simply to increase or to restore a function which has been more or less completely exhausted by overindulgence their use seems to be entirely contra-indicated, but where a mental influence prevents the proper accomplishment of copulation, where overindulgence in sexual intercourse has occurred in extreme youth or through ignorance, or when there seem to be good and sufficient reasons for the begetting of children, their employment is allowable and in many instances perfectly proper. It must be borne in mind, however, that for the *impotence* which is the result of disease, either local or remote, little or nothing can be done. All agents which are excreted by the kidneys and render the urine irritating to the genito-urinary tract increase the frequency and vigour of the erections and augment the prostatic secretion and possibly that of the testicles. This latter result does not follow, as a rule, unless the congestion of the genito-urinary tract is considerable. Although there are no data on this point, it is probable, judging from the effect of this class of remedies upon the lower animals, especially upon fowls, that the vitality of the spermatozooids is lessened in their passage through the urethra on account of the presence of more or less of the particular drug used. Under this head are included *black* and *red pepper*, *can-*

tharis, *turpentine*, the *oils of juniper*, *rue*, and *savine*, *carrot seeds*, *apiol*, *Polygonum hydropiperoides*, and in some cases other essential oils. It is hardly necessary to point out that all these, in large doses, may cause very great irritation of the genito-urinary tract, so that they must be used with great caution and in small quantities. *Cimicifuga* seems to increase the amount of blood circulating through the pelvic organs, and on that account is often valuable in cases in which the testicles are soft and appear to be ill-nourished. *Ergot* is sometimes used in this condition, and is reputed to cause contraction of the dorsal vein of the penis, thus rendering erection more lasting and perfect. The nearest approaches to true specific aphrodisiacs are *phosphorus*, *zinc phosphide*, and the *chlorides of gold* and of *gold and sodium*, and in medicinal doses their use is entirely free from danger. *Nux vomica* and *strychnine*, by their effect upon the spinal cord, strengthen the reflex element and also aid by their general tonic influence. For a while after its introduction to notice *damiana* attracted considerable attention, but soon proved to be without any aphrodisiac action. Irritation of the buttocks and inner surfaces of the thighs by *flagellation*, *nettles*, *mustard*, etc., may excite erections, but as a rule they are temporary and incomplete. A number of mechanical appliances for the creation of a vacuum around the penis and testicles, so as to increase their vascularity, have been suggested, but hardly deserve serious consideration. The application of *electricity* with the view of increasing the nutrition of the parts is worthy of a fair trial and is free from objection. As to *equitation*, there is considerable difference of opinion, due principally to the fact that the Scythians and other races who spent the larger portion of their time on horseback were said to have soon become impotent. However this might have been under such circumstances, anything which tends to increase the amount of blood circulating through the pelvic organs, which moderate horseback exercise will do, must have more or less of an aphrodisiac effect. Some *wines*, especially burgundy, and *liqueurs* are popularly esteemed as aphrodisiacs, but, save as to those varieties that contain a large amount of volatile flavouring bodies, their effect in that direction is probably due to the feeling of well being which follows their use and the conditions under which they are usually taken.

A rational aphrodisiac treatment would seem to be one in which the general condition of the patient is rendered as nearly normal as possible, together with the use of *nux vomica* or *strychnine* given for their effects upon the nervous system, *phosphorus* or *zinc phosphide*, the *chloride of gold* or of *gold and sodium* for its specific effects, and local measures to increase the vascularity of the penis and testicles. These latter should consist in the employment of *electricity*, *hot and cold douches*, and small doses of *capsicum*, *cimicifuga*, or *apiol*. Any attempts at sexual intercourse should be interdicted for at least three weeks after the beginning of the treatment, and in some cases a longer period should elapse. When it comes to those cases in which there is inability to copulate, except under extraordinary conditions, or in which a greater or lesser degree of impotence exists on account of extreme eagerness or some unknown reason, the ingenuity of the practitioner must determine the best plan to be followed, as no two cases are alike and the relief is to be sought through mental influences. It need hardly be mentioned that in all cases phimosis, stricture of the urethra, etc., must receive the proper surgical treatment.

It seems to be taken for granted that the majority of women are frigid and that it is not of much importance whether they are or not, as frigidity has little effect upon their capability of becoming pregnant; but if any case is met with in which the removal of frigidity seems desirable, some degree of success can be attained. The first step is to relieve as far as possible any uterine trouble which may be present, restore the tonicity of the vaginal walls by *astringents* and *douching with hot water*, increase the vascularity of the external genitals by *electricity* and mildly *stimulating lotions*, and augment the vascularity of the pelvic organs by *cimicifuga* or *apiol*.

Russell H. Nevins.

APIOL.—This is a colourless oil having an acid reaction, a pungent taste, and a strong odour of parsley, obtained from the seeds of *Petroselinum sativum*, or common parsley. In large doses it resembles quinine somewhat in its action, causing tinnitus aurium, headache, giddiness, and occasionally light narcosis. It is also slightly *carminative* and, like all essential oils, is a stimulant of the genito-urinary tract, especially in women. On account of its unpleasant taste it is best given in capsules or pills. [A crystallized form of apiol, sometimes called *parsley-camphor*, $C_{12}H_{14}O_4$, occurs in the form of white needles insoluble in water, but soluble in alcohol, ether, or oil, and melting at about 90° F. It has been used in *dysmenorrhœa* and in *intermittent fever* in doses of about 3 grains.]

As an *antiperiodic* it possesses decided virtues, but is inferior to quinine and should only be used when there are some objections to the employment of that drug. In *intermittent fever* the maximum dose, 15 grains, should be given about four hours prior to the access of the chill.

If this plan is thought objectionable on account of the considerable bulk of the dose, the same amount may be given in the course of an hour in divided doses, the last being taken about four hours before the chill is expected. *Malarial neuralgia* is often cured by doses of from 2 to 5 grains three times daily. One- to 3-grain doses are slightly *diaphoretic*, *diuretic*, and *expectorant*, but apiol is rarely substituted for the more efficient and approved remedies of these classes. Like all stimulants of the genito-urinary tract, it is slightly *aphrodisiac*, but it is little used as such and is not very reliable. Its *abortifacient* properties have been greatly overestimated, although it is very largely used abroad for the purpose of producing abortion.

It would be wise, however, not to employ it when pregnancy is present or suspected.

In *neuralgic dysmenorrhœa*, especially when there is any malarial complication, it is particularly useful, but must be given in large doses, from 10 to 15 grains.

In *amenorrhœa* it is of great value, especially in cases where an anæmic condition is at the bottom of the trouble, as it undoubtedly increases the amount of blood circulating in the pelvic organs. In this form of amenorrhœa, particularly where the flow is fetid, it is probably the best remedy of its class. From 8 to 10 grains, associated with some preparation of iron, should be given daily during the week preceding the time for menstruation to occur, and 15 grains on the morning of the day the flow is expected. If constipation exists the action of this drug will be aided by sufficient aloes, in whatever form seems most desirable, to cause a free movement of the bowels every day.—Russell H. Nevins.

APOCODEINE.—Chemically, this derivative of codeine bears the same relation to that alkaloid that apomorphine bears to morphine, and, according to Murrell (*Brit. Med. Jour.*, Feb. 28, 1891, p. 452), it is a valuable *expectorant;* some have affirmed, however, that its action is in no way different from that of codeine. Murrell employed a 1-to-50 watery solution of the hydrochloride for hypodermic use, in doses of from 10 to 15 minims. He gives the caution that the solution must be perfectly neutral in reaction to fit it for hypodermic use. He seems to have used smaller doses by the mouth—from 5 to 20 minims of a 1-to-100 solution.

APOCYNUM (Canadian hemp) is the root of *Apocynum cannabinum*, an indigenous plant official in the U. S. Ph. It has no odour, but its taste is bitter and disagreeable.

In small doses (5 grains of the powdered root) apocynum acts as a bitter. In doses somewhat larger, and especially when given in fluid form, it is both *diuretic* and *diaphoretic* as well as *laxative.* In doses larger still (30 grains) it is a gastric and intestinal irritant, often producing vomiting and diarrhœa. Its virtues are supposed to depend upon the active principles *apocynin* and *apocynein.*

Practically the chief therapeutic application of apocynum is in the treatment of *dropsy*, where by both its diuretic and its diaphoretic powers (the former being the more marked) it is often of great service. Indeed, so decided is its efficiency in some cases of dropsy that the value of the drug has scarcely been given the recognition it deserves, so rarely is it employed.

Apocynum may be given in powder in doses of from 5 to 30 grains, but in that form it is relatively inactive. The fluid extract, *extractum apocyni fluidum* (U. S. Ph.), is more efficient. The dose of this preparation is from 10 to 30 minims. Decoctions and infusions of varying strengths are in more general use. An infusion of $\frac{1}{2}$ a drachm in 1 pint of boiling water will be found an excellent form of administration.—Henry A. Griffin.

APOMORPHINE, *apomorphina*, or *apomorphinum*, $C_{17}H_{17}NO_2$, is an artificial alkaloid prepared from morphine or codeine, usually by heating morphine in a closed tube with an excess of hydrochloric acid. Though other methods are in use, they all act by causing dehydration of the morphine ($C_{17}H_{19}NO_3$), which loses 1 molecule of water. Apomorphine occurs as a whitish crystalline powder which, though official in the Fr. Cod., is seldom used in medicine, the hydrochloride being preferred.

Apomorphinæ hydrochloras (U. S. Ph., Br. Ph.), *apomorphine hydrochloride* or *hydrochlorate*, is official in the Ger. Ph. as *apomorphinum hydrochloricum*, and in the Fr. Cod. as *chlorhydras apomorphinicus.* Its formula is $C_{17}H_{17}NO_2,HCl$. Apomorphine hydrochloride results from the addition of a small quantity of hydrochloric acid to apomorphine in solution. It appears as minute, grayish-white, shining, acicular crystals, without odour, having a faintly bitter taste, and acquiring a greenish tint upon exposure to light and air. It is soluble at 15° C. (59° F.) in about 45 parts of water and in about 45 parts of alcohol; very little soluble in ether or in chloroform. If the salt imparts at once an emerald-green colour to 100 parts of water on being shaken with it a few times in a test tube, it should be rejected, according to the U. S. Ph. The great tendency to decomposition on exposure possessed by apomorphine hydrochloride makes it necessary to preserve the salt in small, dark amber-coloured bottles, and, as this decomposition is especially rapid in the presence of moisture, solutions of the drug rapidly becoming green, it should never be kept dissolved; solutions should always be freshly made when needed. Failure to observe this precaution has resulted, in at least one case, in most serious symptoms.

Though experiments upon animals have shown the physiological actions of apomorphine to be varied, and from them we learn that the drug at first excites the cerebral centres and subsequently depresses them, that in poisonous doses it causes convulsions (probably of spinal origin), that it acts as a direct muscle poison in causing paralysis, that it may increase the rapidity and force of the heart's action and in larger doses cause its depression, that it at first increases the rapidity of respiration and afterwards weakens it, death resulting from respiratory paralysis; yet in man these symptoms are seldom or never observed, and clinically its most important effects are seen in its actions upon the vomiting centre, upon the circulation, and upon bronchial secretion.

Apomorphine hydrochloride acts as an *emetic* through its effect upon the vomiting centre in the medulla only, and this is the case whether it is given subcutaneously or by mouth; it is thus entitled to be considered a "systemic" or "centric" emetic. The superiority of the drug over other emetics lies in its rapidity and certainty of action (in the severer grades of narcotism it is apt to fail as all emetics are), in the small dose required, in the relative freedom of its action from accompanying nausea and depression, in its unirritating quality, if

it is properly and freshly prepared, which renders its hypodermic administration admissible, and in its great efficiency when so given and its consequent value in conditions where swallowing is impossible. Moreover, if emesis is produced by its subcutaneous administration, the gastric irritation to which other drugs owe their power as emetics is avoided. It will indeed produce vomiting if given by mouth, but only at the expense of a larger dose and a longer time.

The rapidity with which apomorphine hydrochloride will produce emesis when administered by hypodermic injection will vary largely with the dose; while a very small dose may require even half an hour to act, a dose of considerable size may be effective within five minutes. The vomiting produced is usually free, and the stomach is completely emptied; after doses of considerable size the vomiting may be repeated once or twice at intervals of a quarter or half an hour. A feeling of fulness in the head or dizziness is not uncommonly an accompanying symptom, but as a rule the action of this drug is far less distressing than that of any other emetic.

Upon the *circulation* apomorphine hydrochloride in small or moderate dose usually produces no effect, such circulatory symptoms as may be present being amply accounted for by the act of vomiting. Exceptionally, however, after moderate doses, and not rarely if the dose is large, circulatory weakening and embarrassment are seen, and the relative frequency of such occurrences in children suggests a special danger attending the use of the drug in such cases and warns us against its administration to children. Even alarming syncope has at times been observed following the use of apomorphine hydrochloride, and death has followed the giving of $\frac{1}{15}$ of a grain to a debilitated adult.

Upon the *bronchial secretion* apomorphine acts to promote and increase its flow and to render it more watery. In this application it is to be classed among the depressing *expectorants.*

Apomorphine hydrochloride in very small doses ($\frac{1}{120}$ of a grain) has been thought valuable as an *antemetic*, the production of emesis or antemesis by it depending, as is the case with ipecac, entirely upon the size of the dose employed. Its use as an antemetic is, however, not common, and it presents neither a constant action nor a superiority sufficient to encourage its further employment.

The production of emesis is its most valuable therapeutic application, and the decided advantages it possesses as an emetic, as well as the character and mode of its action, have already been discussed. Though it will cause emesis if given by the mouth, as has already been said, it is chiefly its efficiency when given hypodermically that makes apomorphine the unique and valuable drug it is, and it is by subcutaneous injection that it is almost invariably given. What the dose should be by this method and for this purpose will depend altogether upon circumstances, the range being from $\frac{1}{20}$ to $\frac{1}{4}$ of a grain. The circumstances upon which the size of the dose should depend are the character and strength of the patient and the exigencies of the situation, for, while $\frac{1}{8}$ of a grain may be well borne by a robust adult, it may be productive of serious results in a feeble one. As a rule the dose should be from $\frac{1}{15}$ to $\frac{1}{10}$ of a grain, and this dose may be repeated after a suitable interval if necessary. If haste is required and the patient is strong, a dose somewhat larger may be given, but $\frac{1}{4}$ of a grain is to be considered the extreme limit and a dose, too, not altogether free from danger. If the drug is given by mouth the dose may be somewhat larger.

An *injectio apomorphinæ hypodermica* (hypodermic injection of apomorphine) is official in the Br. Ph. It contains 2 grains of apomorphine hydrochloride to 100 minims of camphor water. This solution is to be made as required for use. The dose for subcutaneous injection is from 2 to 8 minims.

Another therapeutic application of apomorphine hydrochloride is as an *expectorant* in *bronchial catarrhs*, both *acute* and *chronic*. In the former its use is infrequent, and, though it is by no means commonly employed in the latter, its employment in cases of *chronic bronchitis*, *bronchorrhœa*, and *pulmonary emphysema* has received the indorsement of many. Murrell thinks that "it is a wonderful expectorant and its beneficial effects are far too rarely evoked." The expectorant dose of apomorphine ranges from $\frac{1}{16}$ to $\frac{1}{6}$ of a grain, given by the mouth. If care is exercised to begin with small doses and gradually to increase their size, the administration of $\frac{1}{6}$ of a grain or even more is often unattended by nausea or other symptoms of a disagreeable nature. A spray of apomorphine hydrochloride in solution is occasionally used in respiratory catarrhs.—Henry A. Griffin.

APONE.—An apone is any anodyne, but the name has been given specifically by Poulet to a preparation made after the following formula: Capsicum, $6\frac{1}{2}$ oz.; ammonia water, $3\frac{1}{4}$ oz.; thymol, chloral hydrate, each, $2\frac{1}{2}$ drachms; alcohol, 2 pints. The capsicum is macerated for a month in the alcohol mixed with the ammonia water. It is then expressed, and the chloral and thymol are added. The preparation is to be kept in a well-stopped bottle. It is used externally, painted on the skin pure or diluted with oil, as an anodyne revulsive in *muscular rheumatism, neuralgia*, and other painful affections. Internally, in doses of from 10 to 20 drops in a little water (after swallowing which the patient should drink freely of water or cold tea at once), it is said to have been used with success in the treatment of *hæmorrhoids;* in smaller doses, from 3 to 10 drops, it has been found of service in *dyspepsia.*

APOZEMATA are strong infusions or decoctions made extemporaneously and not intended for prolonged use. Several *apozèmes* are official in the Fr. Cod.

APYONINE, or *benzophenoneide*, is a French preparation intended to serve as a substitute for yellow pyoctanin.

AQUA.—See Water.

AQUOZONE is described as a 3-per-cent. (by volume) solution of ozone in water.

ARACHIS HYPOGÆA is the plant that furnishes the ground-nut, or peanut. Persons suffering with a mild degree of *constipation* have, on the advice of Dr. T. A. Emmet, found relief from eating peanuts rather freely. The nuts furnish a bland oil resembling olive oil; that obtained from the Oriental variety is official in the Ind. Ph. as *oleum arachidis.*

ARANEA.—Under the name *araneæ et tela aranearum* (spiders and spiders' web) there were formerly used in medicine the bodies and the webs of several species of spider, especially those of *Tegenaria domestica*, or the common European house-spider, and those of *Tegenaria medicinalis*, or the American spider. Though these remedies were long since discarded by physicians generally, the older works on materia medica and therapeutics contain references to the employment of spiders and their webs as *febrifuges* and *antispasmodics.* The use, too, of cobweb as a *hæmostatic* application was formerly common and to the present day, indeed, is practised extensively by the laity. The application of cobweb to an open wound should be discouraged and prevented; since, so far from thus carelessly introducing dust and dirt within wounds, our object should be the observance of thorough and careful asepsis.

Henry A. Griffin.

ARAROBA.—See under Chrysarobin.

ARBOR VITÆ.—See Thuja.

ARBUTIN is a colourless glucoside crystallizing in needles, derived from the leaves of *Arctostaphylos Uva ursi* (see Uva ursi). The formula has been given as

$C_{12}H_{16}O_7.H_2O$ and as $C_{26}H_{34}O_{14}.2H_2O$.

The second formula is equivalent to

$2C_6H_{12}O_6 + C_6H_6O_2$(hydroquinone)$+ C_7H_8O_2$,

and free hydroquinone is found in the urine of persons who are under the influence of the drug, to which fact the action of arbutin as an *antiseptic on the urinary tract* is attributed. It is also a *diuretic.* It is said not to be poisonous. It is readily soluble in water, and rather less soluble in alcohol. From 30 to 50 grains may be given in the course of twenty-four hours, in divided doses.

ARBUTUS.—See Uva ursi.

ARCHANGELICA.—See Angelica.

ARCTIUM.—See Lappa.

ARCTOSTAPHYLOS.—A genus of ericaceous plants. For *Arctostaphylos Uva ursi*, see Uva ursi. *Arctostaphylos glauca* is the *manzanita* of the Western States. The leaves are said to contain arbutin.

ARECANE, ARECOLINE, AREKANE, is an alkaloid found, along with *arecaine* (also an alkaloid), in the betel nut. It is a colourless, odourless, volatile, oily liquid. slightly soluble in alcohol, ether, or chloroform, having *anthelminthic* and poisonous properties like those of pelletierine. Its poisonous action has been likened also to that of muscarine. The therapeutical use of arecoline has not yet passed the experimental stage.

ARGENTAMINE is a liquid made by dissolving 10 parts of silver nitrate in 100 parts of a 10-per-cent. watery solution of ethylene diamine. It differs from a simple solution of silver nitrate in not being precipitated by sodium chloride and in not coagulating albuminous substances, while the astringent and antiseptic power of the silver salt is preserved; hence it is thought to come more closely into contact with the gonococcus when injected into the urethra as a remedy for *gonorrhœa.* For this purpose a 1-to-5,000 or 1-to-4,000 solution may be used.

ARGENTUM.—See Silver.

ARISTOL, a German proprietary preparation, is a brownish-red, odourless, unirritating powder, insoluble in water and in glycerin, but soluble in alcohol, in ether, in chloroform, and in the fixed oils. It is precipitated when a solution of iodine in potassium iodide is added to an alcoholic solution of thymol. Chemically it is dithymol diiodide, $C_{20}H_{24}O_2I_2$.

Eichhoff directed professional attention to this substance in 1890. He maintained that aristol was always harmless; that in *psoriasis*, while it acted more slowly than chrysophanic or pyrogallic acid, it had the advantage of never producing any untoward disturbance; that in diseases due to the presence of *vegetable parasites* it acted more favourably than any other medicament; that in *ulcers of the leg* and in *syphilitic ulcerations* it acted more promptly than any other known medicament; and that in *lupus* it was particularly indicated.

Neisser subsequently reported that he had found aristol inefficacious in the treatment of *chancroid, gonorrhœa, lichen ruber*, and *seborrhœic eczema.* His experience has been corroborated by numerous observers, and aristol is considered inferior to iodoform in the treatment of venereal ulcerations.

As an *antiseptic* it has not proved efficacious in *suppurative diseases of the middle ear*, whether used as a powder, an ointment, or a glycerole.

In *chronic rhinitis* and *ozœna* the reports of its efficacy are more favourable.

In *ulcers* that have been disinfected and scraped, aristol stimulates granulation and cicatrization. Cerna speaks of it as having been found highly serviceable as a local application in *interstitial keratitis.*

Aristol may be used as a *local antiseptic* in cases in which iodoform is not tolerated. It may be applied as a powder or in the form of an ointment of the strength of from 30 to 60 grains to the ounce.

[Aristol has been recommended by Haas as a dressing for *burns*, on account of its being somewhat anæsthetic as well as antiseptic. The part is first washed with a boric-acid solution, the blisters are opened, and the burned area is covered with aristol gauze, over which sterilized cotton, gutta percha, and a bandage are applied. When the secretion has diminished, aristol may be dusted on or applied in a 10-per-cent. ointment. (*Practitioner*, Feb., 1895.)]

It has been administered hypodermically in the treatment of *tuberculosis*, and Nadaud has

stated that in from six to seven days the cough and night sweat diminished, and in from twenty to twenty-five days the weight increased. The skin was not irritated by the injections.

SAMUEL T. ARMSTRONG.

ARISTOLOCHIA.—See SERPENTARIA.

ARMORACIA.—See HORSERADISH.

ARNICA.—The dried flower-heads of *Arnica montana*, *arnicæ flores* (U. S. Ph.), *flores arnicæ* (Ger. Ph.), and the root, *arnicæ radix* (U. S. Ph.), *arnicæ rhizoma* (Br. Ph.), are used in medicine. Both have the same physiological effects, but the flower-heads are slightly more active and are more commonly used. Internally, in small doses, arnica increases the action of the heart and stimulates the functions of the skin and kidneys. In large doses it is irritant, nauseates and may excite diarrhœa, depresses the heart's action, dilates the pupils, interferes with the powers of locomotion, and may in some cases induce collapse. Its effects closely resemble those of trimethylamine, of which it contains a small amount and to which its systemic effects are attributed. [A poisonous principle, *arnicin*, which has not yet been proved to be a glucoside, is found in *Arnica montana*. It is said to be febrifuge, but it has not been used much. The plant contains also a volatile oil, which has been given in doses of from 1 to 4 drops.]

On account of its effect upon the heart and circulation it is at times used in *fevers* and *inflammatory conditions*, especially of the *uterus* and *pelvic cellular tissue*. *Rheumatism* and *rheumatic gout* and the *cutaneous eruptions* dependent upon these conditions are benefited by its use. In *mania*, *melancholia*, and *delirium tremens* of an asthenic type it is sometimes used with advantage. Its virtues have been rather overestimated, and its use is now supplanted by that of more efficient remedies. If alcoholic stimulants are not at hand, the infusion may be used in *shock*. *Congestive dysmenorrhœa* is sometimes benefited by small doses at frequent intervals. For internal administration the fluid extract of the root is the preparation most commonly selected.

As an external application to *abrasions*, *slight wounds*, *bruises*, and *sprains*, it enjoys a high reputation in the minds of the laity, but is of little real value, for it is probable that an equal amount of diluted alcohol used in the same manner would be just as efficacious. A plaster made up of equal parts of the extract and of honey, applied fresh every twenty-four hours, will sometimes abort *boils*. Caution must be observed in its external use, as erysipelatous inflammation has been known to follow its too prolonged contact with the skin. This has been attributed to the irritant action of a parasite with which the plant is sometimes infested.

The tincture of the flowers, *tinctura arnicæ florum* (U. S. Ph.), is made with 1 part of the drug to 5 parts of alcohol; that of the root, *tinctura arnicæ radicis* (U. S. Ph.), *tinctura arnicæ* (Ger. Ph.), with 1 to 10 of alcohol. The maximum dose of each is 30 minims. The *tinctura arnicæ* of the Br. Ph. is made with 1 part of the root and 16 parts of rectified spirit, and that of the Austr. Ph. with 4 of the root, 1 of the flowers, and 25 of alcohol. A fluid extract of the root, *extractum arnicæ radicis fluidum* (U. S. Ph.), made by exhausting any desired quantity by its own bulk of a mixture of equal parts of alcohol and water, may be given in doses of 10 minims. A solid extract, *extractum arnicæ radicis* (U. S. Ph.), is prepared in the ordinary manner, but is only used in making a plaster, *emplastrum arnicæ* (U. S. Ph.), which contains 33 parts of the extract in 100, the remainder consisting of resin plaster.

RUSSELL H. NEVINS.

AROMATICS.—The aromatics of the chemists are the benzene derivatives. In therapeutics the aromatics are drugs having an agreeable taste and odour with more or less pungency. Many of them have a mildly stimulating action on the stomach, and some of them are useful for the relief of flatulent colic. (See BITTERS and CARMINATIVES.)

ARROWROOT is a starch obtained from the rhizome of various species of *Maranta*, chiefly *Maranta arundinacea*. It is produced in most tropical countries, especially the West Indies, Africa, and Florida. Bermuda arrowroot is regarded as the best. It occurs as a very light, tasteless, odourless, white powder, having the properties of ordinary starch. Rubbed between the fingers, it gives a slight but peculiar creaking sound. The microscope shows it to be composed of oblong-ovate granules from $\frac{1}{2000}$ to $\frac{1}{150}$ of an inch long, having very fine striations and a circular hilum which cracks in a stellate manner. It is frequently adulterated with other and cheaper forms of starch. Its adulteration is best detected with the microscope.

It is at present less employed in medicine than formerly, when the antiphlogistic plan of treatment was in vogue. Its chief advantage as an article of diet for the sick lies in the fact that it forms an exceedingly smooth, fine, firm jelly without taste or odour. It is usually employed in the form of jelly seasoned with sugar, fruit juices, essences, or aromatics. It has, however, few advantages over several cheaper starches now employed as food, except perhaps that it does not undergo acid fermentation so quickly. As a food for infants, it has the same advantages and disadvantages as ordinary starch, and must be given with the same precautions.

When a very low diet is required a plain *arrowroot mucilage* may be given. This is made by rubbing a tablespoonful of arrowroot powder with a little cold water until a perfectly smooth paste is produced. To this a pint of boiling water is added slowly with constant stirring, and the mucilage is then boiled for about five minutes. It may be sweetened and rendered palatable by the addition of lemon juice, wine, or some fruit extract. Astringent substances precipitate the starch and destroy the smoothness of the mixture; hence astringent wines, especially port wine, should not be used. Milk may be used instead of water if a stronger food is tolerated by the stomach. An

excellent pudding may be made by the addition of eggs to the milk and arrowroot. *Arrowroot blanc-mange* is made by using about three times the amount of arrowroot required for the other preparations, together with milk. It should be boiled down sufficiently to take the form of a mould when cool. Beef tea may be used instead of water or milk, the mixture being boiled twenty minutes instead of five. This may be rendered very palatable, and is an excellent preparation when food of that character is indicated.—Floyd M. Crandall.

ARSENAURO.—This is the trade name of a solution, said to contain in 10 drops $\frac{1}{32}$ of a grain each of gold bromide and arsenic bromide, made according to a process devised by Dr. W. F. Barclay, of Pittsburgh. (See Arsenic and Gold.)

ARSENIC, *arsenum* (U. S. Ph.), *arsenium* (Br. Ph.), is found in nature as a sulphide and as an arsenide of other metals. The arsenio-sulphide of iron is a common arsenical ore. The most frequently found sulphides are the red, realgar, As_2S_2, and the yellow, orpiment or auripigment, As_2S_3. Neither of these is used in medicine. Some mineral waters contain arsenic.

The basis of the arsenical preparations used in medicine is *arsenous oxide*, As_2O_3. This occurs as a white powder, or in white or crystalline masses, soluble in 15 parts of boiling and in from 30 to 80 of cold water.

Arsenical preparations are germicidal to certain organisms. Lacteal and saccharine fermentation are arrested, but the reaction between emulsin and amygdalin and the action of myrosin upon sinigrin are not interfered with. They do not coagulate albumin. Certain bacteria and fungi are not deleteriously affected by arsenic.

Arsenic in solution is absorbed from mucous membranes, the skin, and the subcutaneous tissue. It is excreted by the kidneys and the bowels, and has been found in other physiological secretions, such as the milk and the perspiration. The time required for its complete elimination is from ten to twenty days.

Arsenic has long been supposed to have been an ingredient of the famous *Aqua Tofana* used in Italy as a secret poison in the seventeenth century. Some of the symptoms of arsenical poisoning characterized the effects of this poison, which was usually sold under the name of "Manna of St. Nicholas of Bari."

Whether taken internally or applied locally, arsenic seems to have a selective action upon certain tissues, epithelial and nerve cells. Various explanations of this action have been offered, but none are satisfactory or generally accepted. The fact has, however, been established by clinical observation and by experiments on animals.

Applied to the sound skin, arsenical preparations produce no effect. Upon morbid structures, however, very decided destructive effects are quickly produced. It is especially in cellular new formations, as will be more fully shown further on, that these effects are obtained.

When arsenic is taken internally in small doses no effect beyond a slight sensation of warmth in the stomach is noticed. Larger doses produce some uneasiness, a sense of weight, or actual pain. Still larger doses produce toxic effects—colicky pains, nausea, vomiting, and diarrhœa or sometimes bloody stools. The discharges from the bowels are sometimes of the character known as "rice-water stools," and may simulate those of Asiatic cholera. In a case recorded by Virchow the distinction could not be made out by the post-mortem appearances. Of course, since the discovery of the comma bacillus the bacteriological diagnosis of cholera can be made with certainty. When the drug is taken in substance or strong solution the local effects upon the gastro-intestinal mucous membrane are those of irritation or inflammation. The mucous membrane is reddened, swollen, and eroded in patches. Spots of ecchymosis may also be present. There is at first usually increase of peristaltic activity, but later the intestinal movements are arrested. Fatty degeneration of the abdominal viscera is a constant result of toxic doses. This may be so profound that the patient will die, even if the immediate effects of the poison are not fatal. The liver is usually at first enlarged, but afterwards atrophied. Glycogen and sugar disappear from the liver. The growth of bone is said to be increased, the spongy tissue becoming more compact.

Upon the respiration and circulation arsenic acts in small doses as a stimulant, but in larger doses is depressant. It is said always to lower arterial tension. It is not known positively whether arsenic increases the number of the red blood-corpuscles in health, although in disease it is regarded by many as an hæmatic tonic. It is probable that its tonic influence is generally indirect.

The most marked effects of arsenic are produced upon the skin and the nervous system. The experiments of Miss Emily Nunn have demonstrated that in frogs a poisonous dose will cause exfoliation of the epidermis. The deeper layer of the epithelia, the columnar layer, becomes softened, vacuolated, and separated from the connective tissue below. Sometimes the corneous layer is separated from the Malpighian stratum also. This experimental observation has been verified by an observation of Dr. H. G. Piffard's, who saw extensive exfoliation of the skin in a patient who had taken, by mistake, a teaspoonful of Fowler's solution. The writer has also seen extensive desquamation in a case where arsenic had been taken with suicidal intent. Hunt and De Haen had also observed this effect. According to Miss Nunn, the arsenic acts directly on the epithelial cells, which become shrunken, both in cell substance and in nucleus.

Brownish and greyish discolorations have been noted as effects of the long-continued administration of arsenic. Various eruptions, such as furuncles, papules, and vesicles, sometimes occur. Herpes zoster is sometimes seen in patients taking arsenic. This is probably due to neuritis.

Almost constant effects of the internal use

of arsenic are a silvery appearance of the tongue, a slight reddening and irritation of the conjunctiva, and puffiness of the eyelids. The latter is generally regarded as an evidence of the full physiological influence of the drug and as a measure of the dose to be given in the individual case. The writer has been accustomed to look upon this sign as the clinical line of demarcation between the physiological and the toxic effect of the drug. At times anasarca may occur.

Small doses are stimulant to the nervous system, probably modifying nutrition in the centres and nerves by acting as an irritant. Large doses, or the long-continued use of small ones, may produce symptoms resembling those of poliomyelitis or multiple neuritis. It is probably in this class of cases that herpes zoster occurring in the course of arsenic administration, to which Hutchinson has called attention, belongs.

Poisoning by arsenic may occur not only in consequence of its medicinal, suicidal, or homicidal administration, but from its use in the arts, or from inhaling particles of the poison in rooms painted with arsenical pigments, or of which the walls are covered with paper tinted with arsenical colours. Cases of the latter form of poisoning have been reported by Dr. F. W. Draper, of Boston. Taxidermists and furriers use arsenic largely as a preservative, and sometimes suffer from the effects of the poison. Erosions about the roots of the nails, vesicular or papular eruptions, chronic gastric catarrh, superficial erosions in the mouth, dry tongue, thirst, and a burning sensation in the throat are the prominent symptoms.

The smallest fatal dose is 2 grains of arsenous acid. Much larger doses have, however, been recovered from. While doses as small as $\frac{1}{8}$ of a grain may produce serious symptoms of poisoning in a person unaccustomed to the use of the drug, it is well known that in some parts of the world there are arsenic-eaters—*i.e.*, persons who habitually take arsenic in relatively large doses. Some of the arsenic-eaters in Styria have been known to take as much as 7 grains at a time without any ill effects. Dermatologists also frequently increase the dose of arsenic given for therapeutical purposes, after tolerance has been established. This should be done, however, with great caution, as one can never predict in what cases some of the untoward effects (neuritis, etc.) may occur.

The arsenical preparations taken with suicidal intent most frequently are Paris green (aceto-arsenite of copper) and arsenous acid. The former contains over 50 per cent. of arsenic. Arsenous acid is largely used as a poison for rats, and is thus easily purchased by intending suicides without raising suspicion.

As above stated, one of the prominent symptoms of arsenical poisoning is vomiting. Hence the stomach is usually well emptied by the time the physician reaches the patient—and further attempts at producing emesis are unnecessary. If the arsenic has been taken in the solid form, however (arsenous acid, Paris green), a good many particles remain adhering to the gastric mucous membrane, producing inflammation and erosion and being absorbed after solution. In order to neutralize this remaining poison and that which has passed into the intestine, the chemical antidote must be promptly administered. This is the freshly precipitated *hydrated sesquioxide of iron*. It should be given in large doses, a tablespoonful or more at a time. The antidote forms with the arsenic a very insoluble and an unirritating compound. After the administration of the antidote water should be drank freely and further vomiting encouraged, in order to remove as much as possible of the arsenical compound.

Instead of giving emetics, it will probably be better to wash out the stomach through a stomach-tube. The sesquioxide of iron and stomach-washing should be repeated several times. *Precipitated dialyzed iron* and *saccharated oxide of iron* also may be used. Indeed, the latter preparation is said by Köhler to be better than the sesquioxide. The U. S. Ph. directs that a dilute solution of ferric sulphate and a suspension of magnesia in water be kept on hand, which when mixed form the official arsenical antidote under the name of *ferri oxidum hydratum cum magnesia*. In the absence of either of these preparations, the *tincture of the chloride of iron* may be precipitated with an alkali, soda or magnesia, then washed on a muslin strainer, and administered freely. The *after-treatment* consists in counteracting the depression, relieving irritation, clearing out the bowels by a mild purgative, such as castor oil, and meeting other indications as they arise. The neuritic complications must be treated by rest and anodynes, and later by baths, massage, and electricity.

The mild toxic symptoms sometimes following the too active medicinal administration of the drug usually disappear when the use of the medicine is suspended.

Therapeutics.—For many years arsenic has been the most extensively used internal medicine in the treatment of *diseases of the skin*. Even those dermatologists, like Hebra and Kaposi, who accord to internal medication a very subordinate position in the treatment of skin diseases, recognise the power of this remedy. It has been used so generally in cutaneous therapy that there are few diseases of the integument in which it has not been employed. Naturally when it has been used without proper discrimination many failures have resulted. While the enthusiastic encomiums showered upon arsenic by the late Mr. Thomas Hunt will probably not be indorsed by any one at the present day, there can be no doubt that, when properly handled, this remedy is capable of great good. Dr. Duhring probably represents the best current opinion among dermatologists when he says it is "the most valuable of all internal remedies in the treatment of skin diseases; but the cases in which it is prescribed must be selected if successful results are to be looked for."

As has been stated above, arsenic acts particularly upon the epithelial structures. Such skin diseases, therefore, as those in which the pathological process is chiefly in the epithelial

layer are especially suitable for arsenical treatment. Even in these cases it has been found that in the active congestive or inflammatory stages the remedy is unsuitable and more likely to aggravate than to cure the affection. Hence the mere abstract knowledge that arsenic is "good in skin diseases" is of no value unless the character and stage of the disease are also known and recognised.

The form in which arsenic is given is of some importance. Fowler's solution often produces nausea, on account of its taste. This tendency is easily overcome by giving the medicine in a tablespoonful of sherry wine. The best dose of Fowler's solution to begin with is from 3 to 5 drops three times a day. It should be taken with or immediately after the meals. The dose should be very gradually increased until the limit of physiological tolerance is established. One drop may be added to the daily dose every third day until slight puffiness of the eyelids or redness of the conjunctivæ comes on. The dose should then be slightly diminished and its effects on the disease carefully noted. It will generally be found that in scaly diseases improvement has begun even before the limit of tolerance has been reached. The use of the medicine can be continued indefinitely without bad effects. The dose can often be increased until 12 or 15 drops are taken thrice daily.

Pearson's solution (*liquor sodii arsenatis*) and De Valangin's (*liquor arsenici chloridi*) are sometimes used, but have no advantage over the more familiar preparation.

Arsenic may also be administered in the form of pills. The *pilulæ asiaticæ*, or Tanjore pills, have long been esteemed in the East Indies. They contain $\frac{1}{16}$ of a grain of arsenous acid and one grain of black pepper in each pill. The beginning dose is one pill three times a day.

There can be no doubt of the great value of arsenic in *psoriasis*. Its unquestionable specific action in modifying epithelial tissues renders it an especially appropriate remedy in this disease. Duhring advises that it should not be given in the inflammatory stage, but the writer has found it useful in all stages, when preceded by a saline diuretic, such as acetate or bitartrate of potassium, for a few days. A psoriatic patch will often vanish in a few weeks under the internal use of arsenic alone, without any local medication, although the latter will hasten the disappearance of the eruption. When properly given in this disease, the remedy will rarely fail.

In *eczema* arsenic often acts with almost specific power. It is especially in the chronic papular and scaly stages of the disease that it is so highly useful. In the acute, moist forms of the eruption, the *eczema vesiculosum* or *eczema rubrum* of authors, it usually makes the disease worse, increasing the local inflammation and the itching. In pustular eczema, however, arsenic is often extremely valuable.

Arsenic is the only trustworthy remedy at our command in *pemphigus*. First recommended by Hutchinson as a specific in this disease, its virtues have been proved on frequent occasions by Dr. Bulkley and the writer. The medicine must be given in full doses and freely pushed. Fowler's solution may be given in 8- to 10-drop doses three or four times a day. If given in sherry wine it will be better borne by the stomach than when diluted with water.

The papular eruption termed *lichen ruber* and *lichen planus* by authors is often favourably influenced by arsenic. In the chronic stage especially, where considerable areas of skin are covered by almost solid sheets of the flattened papules, good may be expected from the use of this remedy.

Much difference of opinion exists upon the effects of arsenic in *acne*. In the ordinary inflamed, pustular form it often increases the inflammation and suppuration. Even here, however, minute doses are sometimes useful, and Piffard especially recommends bromide of arsenic in these cases. In the small papular form, and particularly in the periodic eruption in young women coincident with the menstrual period, arsenic in doses of $\frac{1}{100}$ of a grain will usually produce prompt and decided improvement. It is also often useful in *seborrhœa*.

Mr. Hutchinson has found arsenic of value in *lupus erythematosus*, but others have seen no benefit from it in this disease. In some cases of *chronic urticaria* it has been useful, probably by correcting digestive disturbances upon which the eruption depended. It is said also to cause the disappearance of *warts* when given internally.

In certain malignant diseases of the skin—*epithelioma*, *multiple sarcoma*, and *lymphoma*, or *Hodgkin's disease*—the systemic use of arsenic has been highly praised. The writer can corroborate the experience of Dr. Phillips (*Materia Medica, Pharmacology, and Therapeutics*, second edition, p. 516) when he says: "I have given Fowler's solution internally in many cases of epithelioma when the disease was extending rapidly, and have known it apparently retard for a time the progress of the malady, relieve the pain, and improve the general condition." It has also seemed to delay recurrence in cases of operation where the neighbouring glands had become infected.

Multiple sarcoma and malignant lymphoma have disappeared under the internal or hypodermic use of arsenic. In some cases the medicine (Fowler's solution, 5 minims) was injected into the substance of the growths.

Whatever may be the efficacy of arsenic internally in malignant new formations, there can be no doubt of its value as a caustic application in the more superficial forms of *cancer*. Arsenic was employed as a caustic in cancer as early as 1594. In the last century Jean Baseilhac (Frère Jean de Saint-Côme) purchased for 3,000 livres the secret cancer powder the composition of which he afterwards published under the name of Frère Côme's powder. It consisted of arsenous acid, cinnabar, burnt savin, and dragon's blood. This preparation has been modified by Rousselot, Dubois, Hebra, Manec, and others, and been very extensively and successfully employed. Hebra's application consists of 5 grains of arsenous acid, 15 grains of cinnabar, and 2 drachms of simple ointment. It is spread on pieces of cloth and accurately applied to the morbid growth. It

does not destroy normal tissue, and hence, if the growth is covered by normal skin, this must first be removed by caustic potassa or some other non-selective caustic. At the end of twenty-four hours the paste is reapplied, and at the end of the second day another application is made. If the infiltration is not very thick, this usually suffices, but in other cases the procedure must be repeated oftener. When all the morbid tissue has been destroyed, the entire mass comes away in a slough, leaving a healthy granulating surface.

Dr. Alexander Marsden, of London, makes a paste of 2 drachms of arsenous acid and 1 drachm of mucilage of gum acacia. This is made into a thick paste and spread over the cancerous surface. The paste must not be spread over a surface larger than an inch square at a time. It must be sufficiently thick not to run. "A piece of dry lint is then pressed on to the part, overlapping the paste half an inch all round; this must be left for a short period, say ten minutes, by which time any superabundant paste will have been taken up by the extra lint, which is then to be carefully cut away with a sharp pair of scissors; in an hour, or at most two, the lint covering the paste will have become hard and dry, and it will adhere closely and firmly to the cancer. In the course of twenty-four hours the surrounding parts will commence to swell, become red, and to a certain extent inflamed, and the patient will experience a drawing pain. In general this is by no means severe, and does not last more than one or two days. At the expiration of from forty-eight hours to three days, according to circumstances, bread-and-water poultices are to be constantly applied and changed every two or three hours; the pain, redness, and swelling will by this time have subsided, and a distinct line of demarcation be seen extending entirely around the cancerous mass; the skin ulcerates, and a fissure is formed, separating the slough from the healthy tissues; the fissure continues to deepen until the entire cancer comes away, leaving a healthy cuplike depression, varying in size and depth according to the mass removed. Healthy granulation will now commence, and it will be well to continue the poultices for some time; indeed, it often happens that no other application need be used." The slough comes away in from one to three weeks, according to its thickness. In some cases it is necessary to reapply the paste two or three times until a sufficient depth of the morbid tissue has been destroyed, but no fixed rules can be laid down. It must be left to individual experience and judgment. The writer has often used Marsden's paste according to the method described, and can testify to its excellence as a caustic in cancerous growths.

Hebra has spoken very highly of the value of arsenical caustics in *lupus vulgaris*. The ointment above mentioned is used, together with the internal administration of Fowler's solution. It usually requires three or four applications of the caustic to destroy the entire depth of the lupous tissue.

Fowler's solution has been recommended as an external application in *nævus*, being painted on the patch every two or three days. It is said to cause the discoloration to disappear in from four to five weeks. Much reliance can not be placed upon it, however.

Lotions and ointments containing arsenic have been used in animal parasitic skin diseases, such as *scabies* and *pediculosis*. Other applications are, however, less dangerous and probably more efficient.

Arsenic is, next to the alkaloids of cinchona bark, the most trustworthy remedy in malarial infection. In *intermittent fever* it has been used with a success only short of that obtained with quinine. According to Dr. Phillips, arsenic is especially indicated in the quartan type of fever accompanied by marked œdema and prostration. Some practitioners give large doses, up to 30 or 40 drops, of Fowler's solution every two hours until four or five doses have been taken; but this practice seems too hazardous. It is said, however, that such large doses are tolerated only while the fever lasts. It will sometimes arrest the paroxysms of chills and fever when quinine fails. Sir Joseph Fayrer says that "in cases of *chronic malarial poisoning*, with frequent returns of fever, *neuralgia*, and other indications of the chronic action of malaria," he has seen great benefit from the continued use of small doses of Fowler's solution.

In *malarial cachexia* it has a deserved reputation. As a prophylactic against *malarial infection*, arsenic divides first honours with quinine. It is probable that the drug acts as a poison to the malarial organism.

In *anæmia* arsenic ranks next to iron as a reconstructive agent. While its effect is not very marked in *chlorosis*, it is probably the best remedy at our command in *progressive pernicious anæmia*.

In the anæmia of *secondary syphilis* and the wasting diseases of the *puerperal period* it often renders good service.

Dr. Osler regards arsenic, given in large doses, as the best remedy in *leucæmia*.

Arsenic has long held a prominent place as a remedy in *chronic rheumatism* and *rheumatic gout*. In the latter affection it is sometimes used with good effect in the form of baths.

Diabetes has been favourably influenced and often cured by arsenic. In this disease the solution of the bromide has been given by Dr. Clemens, of Frankfort, who extols the remedy highly. This is given in doses of from 1 to 5 drops in some aerated water. The bromide of arsenic may also be given in doses of $\frac{1}{24}$ of a grain, but sometimes proves irritant to the stomach.

Arsenic is one of the best medicinal agents at our command in various neuroses. In *chorea* it may almost be regarded as a specific. It should be given in doses of 5 minims of Fowler's solution, gradually increased. Children bear the medicine extremely well, and doses of 15 drops three times a day can often be given to them. Osler says he has frequently given 25 drops of Fowler's solution three times a day. The best effects are obtained when the full physiological action becomes manifest.

In older children and in adults it may be given by hypodermic injection.

The value of arsenic in *neuralgia* is established. Not only in cases of periodic neuralgia, in which it is almost uniformly successful, but also in chronic idiopathic neuralgias the remedy is an extremely valuable one. It is perhaps more frequently useful in the facial form, but the various visceral neuralgiæ—gastric, hepatic, ovarian, and uterine—are also often relieved or permanently cured by this drug.

Certain *cardiac* and *gastric neuroses* are favourably influenced by arsenic. Dr. Balfour advises it in all forms of *weak heart* accompanied by pain, and the late Dr. Hilton Fagge recommended it especially in the *angina-like pain* present in *aortic regurgitation*. Dr. Anstie found it to materially reduce the pain of *angina pectoris*. In *cardiac dyspnœa*, *palpitation*, and *intermittency of the pulse* Dr. Phillips has found it very useful. *Neurotic asthma* also may be relieved by arsenic. Dr. Leared recommends for this the smoking of paper cigarettes containing arsenic and nitre.

Among the *gastric neuroses* especially amenable to arsenic are the *morning vomiting of drunkards* and the *vomiting of pregnancy*. In both these conditions drop doses of Fowler's solution, before meals, often prove effectual. In *gastrodynia* the effect is often marked. In *gastralgia*, arsenic, according to Sir Clifford Allbutt, "takes by far the chief place: indeed, it is hard to say how gastralgia was cured before the time of its introduction by Dr. Leared."

In *regurgitation of food* unaccompanied by nausea, and in a form of *diarrhœa*, probably neurotic, where a loose motion occurs soon after food is taken, arsenic is of service. In some disorders of the digestive organs not nervous in origin arsenic has been found useful. Thus in *chronic gastric catarrh*, in *dysentery*, and even in *ulcer of the stomach*, it has been used with success. Dr. Ringer professes to have given relief by its use in gastric ulcer after failure of the commonly used remedies.

A. Eulenburg has used arsenic with success to relieve the *tremor* of certain central nervous lesions, such as multiple sclerosis.

Many French physicians have alleged for arsenic a curative action in the early stages of *pulmonary phthisis*. Unfortunately, more extended experience with the remedy does not bear out the statements of its advocates. There can be little doubt, however, that under the use of arsenic the general nutrition is often improved, the congestion and secretion of the bronchial mucous membrane are lessened, the cough is allayed, and the dyspnœa is relieved. It is probable also that in not a few cases, with the improvement of nutrition the tubercular process has been arrested, and thus the patient cured. In no other way can the many favourable reports of its effective use in this disease be explained.

In *coryza*, *hay asthma*, *pulmonary emphysema*, and *chronic bronchitis* arsenic has also been used with good effect.

In certain disorders of the *reproductive organs of women* arsenic has a deservedly high reputation. Dr. Robert Barnes speaks of its value in *chronic vaginal leucorrhœa* with general weakness and relaxation, and other practitioners have found it especially useful in *uterine congestion* and *amenorrhœa*. Dr. Tilt is very enthusiastic in regard to its use in uterine disorders and writes that he has given it with good results in cases of *chronic uterine inflammation* with marked tendency to relapses.

It is also recommended in *pelvic peritonitis*, *chronic oophoritis*, and *menorrhagia*. "Arsenic has brought back too frequent menstruation to its right time and cured dysmenorrhœa; it seems to restrain congestion of the sexual organs, and should be thought of in chronic diseases of menstruation" (Tilt).

Dr. Phillips has given arsenic with success in *hæmorrhoids*, both external and internal. In incipient *cirrhosis of the liver* and certain forms of *intestinal indigestion* it has been found useful. Dr. Brunton cured a case of *albuminuria* due to imperfect digestion of albumin. It has also been used with asserted success in *cystic goître*.

Probably the most startling statement made for arsenic is that it will cure *snake bite*. Dr. Phillips says: "Mr. Ireland used two-drachm doses of liquor arsenicalis with ten minims of tincture of opium every half hour for four successive hours in five cases, and all of them recovered, although other patients died from similar bites."

[*Fowler's solution* is the *liquor potassii arsenitis* of the U. S. Ph., the *liquor arsenicalis* (formerly *liquor potassæ arsenitis*) of the Br. Ph., the *liquor kalii arsenicosi* of the Ger. Ph., the *arsenis potassicus aqua solutus* (*soluté d'arsénite de potasse*) of the Fr. Cod. The processes given in all these pharmacopœias are practically identical, and each of the products contains 1 per cent. of arsenous acid in the form of potassium arsenite. A 1-per-cent. solution of arsenous acid, the *liquor acidi arsenosi* of the U. S. Ph., the *liquor arsenici hydrochloricus* of the Br. Ph., with the addition of 5 per cent. of diluted hydrochloric acid, has the same medicinal uses as Fowler's solution.

Pearson's solution is a solution of sodium arsenate, the *liquor sodii arsenatis* of the U. S. Ph., the *liquor sodii arseniatis* of the Br. Ph., the *arsenias sodicus aqua solutus* (*soluté d'arséniate de soude*, *solution arsenicale de Pearson*) of the Fr. Cod. The American and the British preparations are each a 1-per-cent. solution of the anhydrous arsenate; the French preparation is a 1-to-600 solution of the crystallized salt. Pearson's solution is used for the same purposes as Fowler's and in like doses.

Donovan's solution is a solution of about 1 per cent. each of arsenic iodide and red mercury iodide, the *liquor arseni et hydrargyri iodidi* of the U. S. Ph., the *liquor arsenii et hydrargyri iodidi* of the Br. Ph. The dose is from 2 to 5 drops, to be well diluted and taken after eating.

Boudin's solution, the *acidum arseniosum aqua solutum* (*soluté d'acide arsénieux*, *liqueur de Boudin*) of the Fr. Cod., is a 1-to-1,000 solution of arsenous acid.]—George H. Rohé.

ARTEMISIA.—Several species of this genus of senecionideous plants are or have been used in medicine. *Artemisia Abrotanum*, *Artemisia arborescens*, and *Artemisia pontica* are similar in their medicinal properties to *Artemisia Absinthium* (see ABSINTHIUM). *Artemisia frigida*, indigenous to the northwestern United States, has been used to some extent as a substitute for quinine and as an anthelminthic. It is known also as *sierra salvia*. The unexpanded flower-heads of *Artemisia maritima*, variety *Stechmannia*, constitute Levant wormseed (see SANTONICA). *Artemisia chinensis* and *Artemisia indica* are stomachic, antispasmodic, and tonic. They are also reputed to be emmenagogue and are said to be used in the preparation of moxa.

ASAFŒTIDA is a gum-resin obtained from the roots of *Ferula Narthex* and *Ferula Scorodosma*, indigenous to central Asia, where it is extensively used as a condiment in much the same manner as garlic is. It possesses a most offensive odour, which constitutes a serious drawback to its employment, due to a considerable amount of an essential oil which contains a number of sulphur and phosphorus compounds. Whether asafœtida is taken by the mouth or in an enema, this odoriferous principle enters the blood and soon is very noticeable in the breath and perspiration. Asafœtida is excreted principally by the kidneys, and, while as a rule the quantity of the urine is not increased, it is rendered very irritating, and this is probably the cause of the repute of the drug as an *aphrodisiac* in the countries where it is produced. In over-doses it may cause nausea, vomiting, and diarrhœa, but alarming symptoms rarely ensue. In less than medicinal doses it disturbs the digestion and gives rise to alliaceous eructations and tympanites. When given in doses of from 10 to 30 grains, it increases the flow of the saliva, the secretions of the gastric and intestinal mucous membranes, and those of the liver and pancreas. It is slightly laxative, increases the peristaltic action of the intestines, expels flatus, and promotes digestion, but in nearly every instance causes the most offensive eructations and flatus. The action of the heart is strengthened and a mild stimulant effect upon the brain is observable, which in some cases resembles intoxication in which exhilaration predominates. Its active principle, the oil, is a slight local stimulant and, being excreted by the pulmonary mucous membrane, is ranked as a stimulating expectorant. As a rule, few of the physiological effects of this drug are noticed when it is given to persons in health, and in disease there is a very great difference in the susceptibility of individuals to its influence. For certain purposes there is no remedy which can be substituted for it with as good results, but unfortunately its employment is debarred in many instances on account of the offensive properties just mentioned.

In *hysterical attacks*, using the word in its popular significance, and *hypochondriacal affections* its use is followed by the happiest results; its stimulant effect upon the brain produces such a feeling of well-being and contentment that the morbid depression speedily vanishes and the will-power is sufficient to restrain the patients from the outbreaks of weeping, laughter, etc., so common in such cases. Also, by its action upon the functions of the alimentary canal, it removes the *indigestion*, *constipation*, and *flatulence* which so often are at the bottom of the mental symptoms. In the flatulence of these cases it is more clearly indicated than any other drug, and is best administered in an enema. The *flatulence of children*, unaccompanied by constipation or diarrhœa, is as a rule quickly relieved by small doses given by the mouth rather than in an enema, as children rarely retain enemata long enough for absorption to take place. In the *tympanites* of typhoid fever asafœtida enemata expel the flatus and exercise a mild stimulant effect which is often very desirable. The form of flatulence accompanied by constipation in the aged and feeble is usually overcome by it, but it is better to combine with it a purgative, particularly aloes. Such a combination is the compound asafœtida pill. Like a number of other bodies of a strong and offensive odour, asafœtida is reputed to have anthelminthic properties, but they are not sufficiently well marked to make it of any decided value in that direction. In the *chorea* of young girls, at about the age of puberty, which is associated with or dependent upon delayed or irregular menstruation, it is often valuable, but in the ordinary forms it is not to be depended upon. Having slight emmenagogue properties, it is a valuable addition to aloetic purges when such are indicated.

After the acute stage of *whooping-cough* has subsided it is often of benefit in diminishing the violence of the paroxysms, especially in cases in which there is more or less oppression of the breathing during the intervals between the attacks of coughing. In the sympathetic cough which sometimes occurs in those who are in contact with whooping-cough patients it is generally serviceable, particularly when combined with ammonia, as in the fetid spirit of ammonia. As a stimulating expectorant it has been used with considerable success in *chronic* and *subacute laryngeal* and *bronchial affections*, more particularly where a spasmodic element exists. Formerly it was used extensively in the treatment of *asthma*, but it is scarcely valuable enough in that condition to be recommended except when the more approved remedies have failed.

[To prevent *threatening abortion* and to overcome "habitual abortion," asafœtida has been recommended in Italy, and Warman (*Therap. Mntsh.*, Jan., 1895; *Brit. Med. Jour.*, Mar. 2, 1895) has lately reported very favourable results from its use for these purposes. At first, 3 grains, in pills, are given daily, and the amount is gradually increased until 15 grains a day are taken; but in urgent cases of threatening abortion an enema containing the tincture is preferred.]

The gum may be given in doses up to 30 grains, but it is not a desirable form in which

to employ the drug. The emulsions and tinctures are less disagreeable to take and prompter in action. For enemata, either the emulsion or the tincture, diluted with the desired amount of water, is most commonly used. The pills, except when combined with a cathartic, are open to the same objections as the gum. The emulsion (*emulsum asafœtidæ*) of the U. S. Ph. contains 1 part of the drug in 25 parts of water, and may be given in doses of from 1 to 2 tablespoonfuls. The pills (*pilulæ asafœtidæ*) contain each about 3 grains. The pills of aloes and asafœtida (*pilulæ aloes et asafœtidæ*) are made of equal parts of those drugs and of soap, each pill containing 2 grains of aloes and of asafœtida. The tincture (*tinctura asafœtidæ*) contains 1 of asafœtida in 5 of alcohol, and may be given in doses up to a fluidrachm. The Br. Ph. orders a pill of aloes and asafœtida (*pilula aloes et asafœtidæ*) of the same strength as those of the U. S. Ph.; an *enema asafœtidæ*, containing 30 grains of the drug in 4 fl. oz. of water; a tincture (*tinctura asafœtidæ*) of essentially the same strength as that already described; a compound asafœtida pill (*pilula asafœtidæ composita*) which contains equal parts of the asafœtida, galbanum, and myrrh, and is given in doses of from 5 to 10 grains; and the fetid spirit of ammonia (*spiritus ammoniæ fœtidus*), each drachm of which contains about 10 grains of asafœtida. The Fr. Cod. gives a simple and an ethereal tincture, of practically the same strength as the U. S. and Br. preparations.

RUSSELL H. NEVINS.

ASAPROL is a crystalline compound of calcium with the alpha-monosulphonate of beta-naphthol. It is neutral and unirritating, readily soluble in water and in alcohol. It is antipyretic, antiseptic, analgetic, and diuretic. It has been used very successfully in *influenza* and *pneumonia* as an antipyretic which does not seem to depress the heart's action. It has also been employed in the same way, and with fair results, in *typhoid fever* and other *acute febrile diseases*. Dr. Cerna states that when these fevers are accompanied by *albuminuria* the use of asaprol is shortly followed by the subsidence of that symptom. In the treatment of *rheumatism* its use seems safer than that of the salicylates, but not quite so efficient. Used as an analgetic, asaprol has given good results in various forms of *neuralgia* and in *rheumatism*. Its employment as an internal antiseptic seems to be of value in the treatment of *fermentative dyspepsia* and of *boils*. It has also proved palliative in attacks of *asthma*. Asaprol may be given in substance or in solution. The dose is from 15 to 60 grains. For antiseptic gargles and rectal, vaginal, and urethral injections Dr. Cerna mentions solutions varying from 2 to 5 per cent. in strength.

ASARUM.—A genus of aristolochiaceous plants. *Asarum canadense* and *Asarum arifolium*, wild ginger and Canada snakeroot, furnished the *radix asari* formerly official in the U. S. Ph. It appears to be almost inert. *Asarum europæum* is still official in the Fr. Cod. The root and leaves, dried and powdered, are emetic and cathartic in doses of from 30 to 60 grains.

ASCLEPIAS CURASSAVICA.—This tropical shrub has been put to various uses in medicine. The juice is a violent emetic and cathartic in doses of from 3 to 9 drops, and has been used as an anthelminthic. The leaves are reputed to be hæmostatic and antiblennorrhagic. Great caution is to be observed in the use of any form of the drug.

ASCLEPIAS GIGANTEA.—See CALOTROPIS.

ASCLEPIAS TUBEROSA, pleurisy-root, is an indigenous plant the root of which is the *asclepias* of the U. S. Ph. Its therapeutic value lies chiefly in its power to produce diaphoresis as well as the moderate effect it has as an expectorant. Both these actions are associated with a considerable depression of the heart's action and weakening of the circulation. A slight diuretic power is also attributed to asclepias. In large doses it acts as a gastric and intestinal irritant, producing vomiting and diarrhœa.

The drug is one which now finds but little employment, and so little esteem is it held in that most treatises on materia medica fail to give it consideration. In fact, it presents no particular advantage over other drugs of its class, and is relatively inactive. In simple *febricula* its diaphoretic action is of some value at times, and in "*colds*," especially those marked by *catarrh of the respiratory tract*, by acting both as a diaphoretic and as a depressing expectorant it will often relieve the symptoms considerably.

In the *acute exanthemata* its action upon the skin has appeared to "bring out the eruption," while from its diaphoretic action it is slightly antipyretic. The action of asclepias is enhanced by its administration in fluid form; and while the fluid extract is the more elegant preparation, an unofficial infusion (1 oz. to 1 pint) is rather more effective. Thus prepared, asclepias is used somewhat in the Southern United States as a household remedy. Of this infusion the dose is from 1 to 2 fl. oz. The dose of asclepias in powder is from 20 to 40 grains; that of the fluid extract, *extractum asclepiadis fluidum* (U. S. Ph.), is from 15 to 30 minims.—HENRY A. GRIFFIN.

ASEPSIN.—See ANTISEPSIN.

ASEPTOL, orthophenolsulphonic acid, $C_6H_4OH(SO.OH)_2$, is a reddish, oily liquid smelling feebly of carbolic acid. It is readily soluble in water, and to that fact it doubtless owes any superiority it may have over carbolic acid as an antiseptic. It may be given internally in doses somewhat larger than those of carbolic acid.

ASPARAGIN is a crystalline principle, $C_4H_8N_2O_3 \times H_2O$, found in *Asparagus officinalis* and in several other plants. It has been used as a diuretic to the extent of from $\frac{3}{4}$ of a grain to 2 grains daily, in divided doses. According to Cerna, a mercurial compound called asparagin hydrargyrate has recently been used, with alleged excellent results, in the treatment of *syphilis*, in hypodermic injections of $\frac{1}{6}$ of a grain.

ASPARAGUS.—This vegetable has been credited with acting as a diuretic, but, as Dr. Samuel Wilks has remarked (*Lancet*, April 28, 1894), probably without good reason.

ASPARAMIDE.—See ASPARAGIN.

ASPIDIUM (U. S. Ph.), *filix mas* (Br. Ph.), *filix* (Ger. Ph.).—Under these names may be grouped the rhizomes of *Aspidium Filix mas* and of *Aspidium marginale*. The male fern has long and with great justice been regarded as one of the most effective and perhaps the best tæniacide of which we have knowledge. The only drawbacks to its use are the size of the dose required and its nauseating effects. It is reputed to be more effective against the unarmed variety of tapeworm than against the armed, but if the proper precautions (cf. ANTHELMINTHICS) are observed it is as effectual in the one case as in the other.

Either the powdered rhizome or its oleo-resin, preferably the latter, may be used. The dose of the former is from 30 to 90 grains, and that of the latter from ½ to 1 fluidrachm, according to the age of the patient, repeated two or three times at intervals of an hour. The oleo-resin must be given in capsules, on account of its nauseous taste. These capsules are put up by all the large drug houses, and if a reliable brand is selected are entirely satisfactory.

The last dose is to be followed in the course of an hour by a cathartic unless a spontaneous action of the bowels has occurred bringing away the entire worm.

If an attempt with this remedy fails of success it is probably better to try one of the other tæniacides, as many patients seem to be entirely unable to retain it, no matter what precautions have been adopted. For the treatment preparatory to the use of this remedy, see ANTHELMINTHICS.

Aspidium rigidum, which is a native of the Pacific slope, is used for the same purposes as the varieties above mentioned.

Excessive doses, as little as 6 drachms in one case, have been followed by alarming symptoms and by death in a few cases. The drug causes emeto-catharsis, vertigo, headache, cyanosis, maniacal excitement, convulsions, and coma. Stimulants and nerve sedatives are the proper remedies if these complications should occur. As castor oil is said to increase the rapidity with which the active poisonous principle of this drug is absorbed, it is wise to avoid its simultaneous use. The oleo-resin, *oleo-resina aspidii* (U. S. Ph.), is essentially the same as the extract, *extractum filicis liquidum* (Br. Ph.), *extractum filicis* (Ger. Ph.), which is an oily ethereal extract.—RUSSELL H. NEVINS.

ASPIDOSAMINE, ASPIDOSPERMA, ASPIDOSPERMATINE, ASPIDOSPERMINE.—See under QUEBRACHO.

ASPIRATION, in the therapeutical sense, is the removal of a liquid or gas from some part of the body by means of suction with an aspirator, a hypodermic syringe, or an exploring syringe, in such a manner as to prevent the ingress of air. Attention was directed to this procedure by a paper by Dr. G. Dieulafoy, published in the *Gazette hebdomadaire de médecine et de chirurgie* for November 5, 1869, in which he described under the term "subcutaneous aspirator" an instrument that resembles the well-known exploring syringe of the present day. He proposed that this instrument should be employed as a means both of diagnosis and of treatment in deep abscesses, cysts, or other serous or purulent collections, and to remove gas from the intestine. In 1851 Dr. Henry I. Bowditch read a paper before the Boston Society for Medical Observation, in which he referred to the removal of pleuritic effusions by pneumatic suction, and described a method that had been employed by Dr. Morrill Wyman, of Cambridge, Mass., which was simpler, less dangerous, and more effectual than paracentesis. In this paper Dr. Bowditch gives his reasons for objecting to paracentesis by incision, and he states that Dr. Wyman used the smallest kind of exploring trocar and cannula, the calibre of the latter being about that of a large-sized aspirating needle. One extremity of a non-collapsible gum-elastic tube was attached to the cannula by means of a screw, and the other extremity was screwed to the nozzle of a brass suction pump. The pump was so arranged that after the piston was withdrawn and the barrel filled, a simple turn of a cone forming the nozzle enabled the contents of the syringe to be discharged through a lateral aperture and the pleural effusion could thus be removed without withdrawing the instrument.

A number of instruments have been invented for the purpose of aspirating. Indeed, before the publication of Dieulafoy's paper the suction trocar was an instrument that accomplished more clumsily what Dieulafoy's aspirator is intended to do. The fundamental feature in all these instruments is a receptacle or apparatus in which a vacuum may be created and maintained, connected by a rubber tube with a cannula to be thrust into the region that is to be explored. A hypodermic syringe makes an excellent aspirator for diagnostic purposes, but the larger needles and stopcocks accompanying an exploring syringe afford a wider range of usefulness, because a liquid too dense to pass through the fine hypodermic needle or to be withdrawn by the slight suction it produces will usually pass readily through the large needles of the exploring syringe. The aspirator proper is applicable to all cases in which the removal of a physiological or pathological fluid is desired. The needles are of the diameters ½, 1, 1½, and 2 millimetres, or $\frac{1}{50}$, $\frac{1}{25}$, $\frac{1}{20}$, and $\frac{1}{12}$ of an inch respectively.

Before using an aspirator it should be carefully cleansed by washing out the needles, or cannulæ, the tube, and the chamber of the air-pump, if the instrument is one in which the liquid is drawn into the barrel, by using first ordinary hot water, then a solution of sodium bicarbonate or liquor potassæ, then again hot water; if the barrel is of glass, care must be exercised that the water is not so hot as to break it, then the chamber may be filled with a carbolized solution and the instrument allowed to lie therein for some hours preceding its use. It is a measure of safety to sterilize the needle or can-

nula thoroughly, because if a septic process follows the introduction of the aspirator needle into a non-septic effusion, that consequence results either from slovenly cleansing of the needle or syringe or of the skin over the collection to be aspirated. Boiling the needle for a few minutes in a test-tube containing a solution of sodium bicarbonate or liquor potassæ is an efficacious method of sterilization, but the needle should not then be taken out of the tube by unclean fingers; it is better to allow it to remain there or in a carbolized solution until the preparations have been completed for the operation and the physician is prepared to introduce the needle.

The apparatus having been cleansed, the skin through which the needle is to be introduced should be cleansed with soft soap, hot water, and ether, as is customary in the cleansing of any field of operation. The physician then draws the skin tense over the region, in order that its subsequent relaxation may make a valve covering the subcutaneous needle-puncture. The needle, which should be well sharpened. is pressed in with a screwing motion, no effort being made to change its course after it has pierced the skin, until its point reaches the locality or cavity to be examined. If there is no flow of fluid the needle should be withdrawn and introduced at another point; if a syringe is employed, and it is thought that the fluid does not flow on account of its density, the syringe may be partly filled with a warm solution of carbolic acid (2·5 per cent.) or a sterile warm normal salt solution, and after the needle is inserted the fluid should be injected slowly. This will dissolve any thick pus in its immediate vicinity, and in a few moments the injected fluid may be withdrawn. Its change of colour will indicate the presence of pus.

The physician should not press or squeeze the affected region, because this will not increase the flow of the contained fluid, and it may cause injury to the internal granulations. If blood comes in any considerable quantity the aspiration should be discontinued. Should the needle become choked during aspiration, a little of the fluid should be forced back into the cavity, in order to drive out the occluding clot from the cannula. When the aspiration (with the irrigation, if it is performed) is completed the needle should be withdrawn quickly, the vacuum being maintained so that no fluid may escape from the needle into the puncture tract. The injection fluid may, when irrigation is performed, be a source of infection, many such preparations being rich in bacteria when they come from the pharmaeists. Such solutions should be sterilized.

Aspiration has been employed in the treatment of *chronic hydrocephalus*, in which it has supplanted the older operation of paracentesis. The finest needle should be employed, and it is introduced perpendicularly through the anterior fontanelle, after shaving and disinfection of the scalp of that region. The puncture is made on one side of the median line, so as not to injure the superior longitudinal sinus. The liquid should be withdrawn slowly, and, as a rule, not more than two or three ounces should be removed at one time. If the fontanelle is closed the fluid may be removed by Dr. W. W. Keen's method, in which a button of bone half an inch across is removed from the skull at a point an inch and a quarter behind the auditory meatus and at the same distance above Reid's base line. This line is an imaginary straight line running from the inferior margin of the orbit through the middle of the external auditory meatus. The aspirator needle is directed towards a point two inches and a half above the opposite meatus and introduced until the diminution of resistance shows that it has entered the lateral ventricle. The fluid is slowly withdrawn. Dr. Keen has practised permanent drainage by the introduction of three or four horsehairs through the needle track, but there is less risk of secondary infection if there is no permanent drainage, successive tappings being performed as required.

The removal of the cerebral fluid is sometimes followed by convulsions. They may be checked by reversing the action of the aspirator and injecting an artificial cerebro-spinal fluid or some innocuous sterilized liquid. Indeed, Dr. Keen recommends irrigation of the cavity with a boric-acid solution, or tincture of iodine may be injected cautiously for the purpose of causing a radical cure. The latter method has caused death.

After tapping, the skull should be compressed by passing strips of diachylon plaster over the head from front to back and diagonally from side to side, so as to diminish the possibility of reaccumulation. In every detail the operation should be aseptic. Aspiration is much more likely to result favourably if it is performed as soon as the hydrocephalic condition develops than if it is postponed until the pressure has produced structural changes in the cerebral tissue. Quincke has proposed tapping the theca of the spinal cord and thus draining the ventricles at a distance.

In *spina bifida* the sac may be aspirated by introducing the needle obliquely, on one side, through the skin, the child lying on its side. Only a small quantity of fluid should be withdrawn at first, and a drachm of the following mixture is to be injected into the sac:

℞ Iodine............ 10 grains;
Potassium iodide... 60 "
Glycerin.......... 1 fl. oz.

The child should be kept quiet on its side after the injection and the physician should assure himself that no leakage follows the puncture. The injection may be repeated at intervals of a week or ten days.

In *pleurisy with effusion*, if the fluid produces respiratory or circulatory disturbances, immediate aspiration is indicated; also, if the effusion is complicated with *pericarditis*, *valvular heart disease*, or *pneumonia*, the fluid should be evacuated. Neither prostration nor fever is a contra-indication of the operation. If the patient is strong enough, the sitting posture is assumed, the hand of the affected side is placed on the opposite shoulder, and the needle, after preliminary disinfec-

tion, is inserted in an intercostal space, usually the eighth or ninth, either just below the lower angle of the scapula at the back, or laterally just in front of the latissimus dorsi muscle. The needle is introduced in an upward direction so as to avoid puncturing the diaphragm and the possibility of injuring the liver on the right side or the spleen on the left. In very nervous patients local cocaine anæsthesia may be produced before introducing the aspirator needle, and preliminary stimulation by a hypodermic injection of a solution containing $\frac{1}{20}$ of a grain of strychnine, $\frac{1}{120}$ of a grain of atropine, and $\frac{1}{8}$ of a grain of morphine is indicated in feeble adults, because fatal shock has followed the mere introduction of the aspirator needle.

The rules originally laid down by Dieulafoy in regard to the scope of aspiration in *empyema* have not been improved upon. He advised repeated aspiration, but if such procedure, with or without pleural lavage, failed to remedy the condition, he advised free drainage and irrigation. If the empyema is of tuberculous origin, or if the fluid contains large quantities of clots, as shown by the frequent clogging of the needle, aspiration should be abandoned and a radical operation performed.

There is much difference of opinion regarding the complete evacuation of the contained pleural fluid, and of the utility of irrigation. These morbid conditions without doubt cause self-intoxication, and there is often a very nice balance between the state in which the system resists the toxic influence and that in which it succumbs to it. The shock of even so slight an operation suffices to disturb the equilibrium and there are depression, convulsions, and even death. It is on this account that the preliminary subcutaneous injection of morphine, atropine, and strychnine was recommended above. In the writer's personal experience complete evacuation of the fluid has not been productive of harm, and with the precautions indicated he would advise this course. He does not agree to the dictum that irrigation is unnecessary and even dangerous, and there is no rationale that will support the idea that death occurring during pleural irrigation is due to the latter. Cleanliness of a suppurating pleural cavity is as essential as cleanliness in any other region, and the use of Dieulafoy's aspirator or some similar instrument should be followed by irrigation with a 5-per-cent. boric-acid solution of a temperature of from 100° to 102° F., or of a warm solution containing 2·5 per cent. of creosote and 5 per cent. of sodium bicarbonate, or even of a normal salt solution.

In *hæmothorax* aspiration should be employed to remove the effused blood, especially if it produces dyspnœa.

In *hydrothorax* due to cardiac, hepatic, or renal disease, or to a vaso-motor paresis arising as a complication in the final stage of some acute disease, the fluid should be removed by aspiration and the pleural cavity irrigated.

In *pneumothorax* in which there is considerable intrapleural pressure, with consequent dyspnœa, the contained air may be evacuated by an aspirator.

A rare condition has sometimes followed the removal of fluid from the pleural cavity, in which dyspnœa associated with a profuse, thin, frothy, albuminous sputum terminates fatally in pulmonary œdema.

In *pericarditis with effusion* and in *hydropericardium*, the fluid should be removed by aspiration, because the mechanical pressure it exercises on the heart may cause death, and it undoubtedly enhances the likelihood of heart failure. The operation should be undertaken before exhaustion, pulmonary engorgement, and degenerative myocarditis render permanent relief impossible. In tapping the pericardium the needle should be introduced in the fifth intercostal space, from 2 to $2\frac{1}{4}$ inches to the left of the median line of the sternum. The needle is passed obliquely upward and inward, and the pumping should begin as soon as the point is beneath the skin, so that the flow of fluid will be observed as soon as penetration of the pericardium has been effected.

In *suppurative hepatitis* the introduction of the aspirator needle will establish the diagnosis, empty the abscess cavity, and sometimes result in cure. The patient should be anæsthetized, and the puncture should be made in the seventh right intercostal space, in the axillary line, the needle being directed towards any tender spots below the costal cartilages. If no pus is obtained by the first puncture, withdraw the needle and reintroduce it. Harley and others assert that the needle may be introduced a score of times without causing injury to the liver. If, of course, there is distinct fluctuation over the anterior surface of the gland, the needle should be introduced into that point. After the pus has been withdrawn it is well to irrigate the abscess cavity with a 5-per-cent. solution of sodium biborate, with a 2·5-per-cent. carbolic-acid solution, or with a normal salt solution, of a temperature of from 100° to 103° F. After irrigation the needle should be quickly withdrawn, the external cutaneous puncture closed with iodoform-collodion, the abdomen tightly bandaged so as to oppose the liver's capsule and the abdominal parietes, and the patient kept quiet. Recovery has been reported, following this method, in an abscess containing 108 oz. of pus. If the abscess fills anew it may be aspirated again, and ammonium benzoate should be given in 10-grain doses every two hours, for its local action on the liver.

Aspiration may be employed for the operation of *hepatic phlebotomy* recommended by G. Harley as a remedial measure in *chronic congestive hepatitis*. From three to six punctures are made into the liver lobes, and some drops of blood withdrawn. Following the puncturing the abdomen is tightly bandaged.

Hepatic echinococcus may be treated by aspiration and injection of the sac with tincture of iodine or with a mild warm bichloride-of-mercury solution (1 to 2,500). This operation, like all others with the aspirator, should be absolutely aseptic. Hydatids affecting other organs may be treated in the same way.

In *nephrydrosis* the needle may be introduced in a forward and vertical direction, at a

point just below and anterior to the last rib, or at a point 2½ inches posterior to the centre of a vertical line drawn from the last rib to the anterior superior iliac spine.

In *intestinal occlusion* in which there is gaseous distention, also in *hernia* in which taxis has failed to reduce the protrusion, the finest aspirator needle may be introduced and the gas removed. This relieves the pain caused by the distention, and in hernia it diminishes the bulk of the swelling and favours its reduction.

In *perityphlitic abscess*, especially that form designated as *iliac phlegmon*, aspiration is of value in confirming the diagnosis, and the needle is a good guide for the surgeon's knife.

In *ascites* nothing is better than aspiration. The largest needle is smaller than the ordinary small trocar, and is less painful to introduce. The patient's bladder should always be evacuated before aspiration is performed, and the operator must be sure that, if it is a woman, she is not pregnant. The patient may sit on the edge of the bed, or sit up in bed and be supported by a nurse or by pillows, while the fluid is being removed. This operation may be repeated as often as necessary, and it is the writer's practice to withdraw as much fluid as possible and to bandage the abdomen after the operation so as to compensate for the withdrawal of the fluid pressure on the intra-abdominal blood-vessels.

In *cystic tumors of the ovary* or of the *broad ligaments* aspiration is not considered justifiable as a general thing. Its use is recommended in cases in which there is some acute disease that forbids an immediate radical operation, and so competent an observer and skilful a surgeon as Dr. T. G. Thomas has said that he was in the habit of aspirating the sac a month or so before ovariotomy in order to give the patient a chance to improve in her general health. Cases have been reported of cure of cysts of the broad ligament by one aspiration. Death due to peritonitis following aspiration has been reported, but with our present surgical knowledge this result is believed to be the fault of the operator and not of the operation.

Retention of urine due to *stricture*, *hypertrophied prostate*, or *ruptured urethra* is quickly relieved by aspirating the bladder. The needle may be passed through the skin, just above the pubes, and directed slightly towards the floor of the pelvis, the vacuum being established as soon as the point is within the skin. Anæsthesia is rarely required, as a single quick motion results in penetrating the bladder. Another method is to place the patient in the lithotomy posture, when the operator introduces his finger into the rectum and feels for the *trigonum vesicæ*, and then passes the aspirator needle along his finger into the bladder. There is less risk of septic infection following the suprapubic than the rectal method. The operation may be performed twice a day for several successive days.

In *abscesses* the pus may be removed and the cavity gently washed out with a warm saline, mercuric-chloride (1 to 4,000), or carbolized (2·5 per cent.) solution by means of the return current, and finally injected with an emulsion of 1 part of iodoform in 10 parts of glycerin; the last-named solution is to be left in the abscess. This treatment is desirable for abscesses in regions where free incision and packing would be likely to leave an unsightly scar.

Aspiration may be employed for either diagnostic or therapeutic purposes in any *fluctuating enlargements of joints*. Serum, blood, or pus may be removed quickly and safely by this method. In suppurative or serous tubercular joint swellings aspiration should be followed by the injection of a 5-per-cent. emulsion of iodoform in oil or glycerin or by the injection of a solution of zinc chloride, 10 to 30 grains to the ounce. After the operation the patient should be kept quiet and the joint immobilized.—Samuel T. Armstrong.

ASTERACANTHA LONGIFOLIA, or *Hygrophila spinosa*, is an East Indian acanthaceous plant. The root is said to be a powerful diuretic, and the seeds are reputed diuretic and aphrodisiac. A decoction of 1 part of the drug in 10 parts of water is given in daily amounts of half a teacupful.

ASTRINGENTS are agents that produce contraction and condensation in living tissues, resulting in a diminution in the fluids of the parts acted upon, and consequently diminish or stop secretion, exudation, or hæmorrhage from them. The name astringent is one which has been too loosely applied, and the employment of such terms as "gastric astringent" and "intestinal astringent" is misleading and incorrect, since an astringent is an astringent and nothing more, whatever its chief application may be, whether it acts upon the stomach, the intestine, or the skin, for in all cases, if it truly is an astringent, its methods of operation are the same. There has even been described a class of "vascular astringents" whose action is said to be to produce arterial contraction, but when this class is seen to include digitalis and ergot it becomes evident that we are considering drugs in no way entitled to be classed as astringents, but drugs which are vaso-constrictors. The word astringent, too, has been employed as a class name for those agents which act to produce constipation, and, though indeed astringents do constipate by producing a diminution of intestinal secretion, yet this is but one of their actions, and it is therefore incorrect to give to a part the name which properly belongs to the whole. Clinically, this employment of the word astringent as a synonym for constipating is so common that it has been accepted by general usage, but, strictly speaking, this application of the word is both incorrect and inadmissible.

It was formerly thought that astringents owed their action to a power of coagulating albumin or to the production of muscular contraction. That neither of these explanations holds good is proved, as noted by Wood; the former is shown not to be true by the fact that the effect of astringents is not permanent, and the latter is false because their action is also seen in parts which contain no

muscular fibre. Exactly how it is, then, that astringents produce their effect we cannot as yet say, but must be content to attribute the action to a property inherent in the tissues themselves by virtue of which they thus respond upon contact with the astringent agent. The coagulation of albumin and gelatin by the action of astringents is, of course, a common occurrence, and it is illustrated in dead tissues by the process of preparing hides and skins by tanning. Whether it is a similar process by which they affect living tissues is not demonstrated, but, though the processes may be similar, they clearly are not identical. The contraction of muscular tissues by the action of astringents in the living body is frequently a factor in the production of their effects, but that it is an essential is disproved by a fact already mentioned.

The action of the astringent drugs results only from their direct influence upon the tissues to which they are applied, for their action is purely a local one and nervous influences play no part in it. It is true that they often show effects upon distant organs, but only when they are in some way carried to them and, hence, ultimately applied locally. Thus the circulation is the vehicle by which gallic acid reaches deep-lying viscera, on which it is said to produce its astringent effect, an example of which is supposed to be seen in the diminution of renal exudation or hæmorrhage following the use of that drug.

Though in strength there is the greatest of difference between the various astringents, yet they all are capable of passing the bounds of simple astringency, for, when applied for too long a time or in undue concentration and strength, they become irritants, and as such are as potent for harm as their more moderate employment would be for good. This tendency of the astringents as a class is not to be lost sight of, else the results may be disappointing or unfortunate.

The therapeutic applications of the astringents are suggested by their very name; for if to condense, to contract, to cause shrinkage is their function, then must their application be in conditions of relaxation and atony. This, then, is the proper field of usefulness for astringents, and they are indicated in relaxation from any cause, provided the organ or tissue relaxed is one which can be reached and acted upon locally by the agent. Thus *subacute* and *chronic diarrhœas* are benefited, since in them the supersecretion is generally an evidence of intestinal relaxation. And what has been said of intestinal catarrhs applies to the *chronic inflammations of mucous membranes* generally, especially since, as a class, they can, at least to some extent, be directly reached and acted upon by sprays, injections, and other applications. The direct application of astringents also to cutaneous *sores* and *ulcerations*, if they are sluggish, relaxed, and perhaps discharging abundantly, is followed by a firmer and a healthier condition, a diminution of secretion, and an increased rapidity of granulation and healing.

If *subacute* and *chronic inflammations* are so often the indications for the employment of astringents (since it is in these conditions that local relaxation is most frequently found), on the other hand, acute inflammations must generally be regarded as contra-indications, for relaxation is not present, but the condition is one of marked congestion, and, though exudation and discharge may be copious, they are generally the evidences of Nature's attempt to cure. Interference with them, therefore, by confining them within the tissues is generally unwise and even hazardous. Under such circumstances the only exception to the general contra-indication to astringents is the jeopardy in which such discharges, if copious, may place the patient and the consequent necessity of interference to save life. Even here their use, though perhaps necessary, is irrational. It is in cases of acute inflammation, too, especially in its earlier stages, that the irritating properties of astringents are most likely to be seen, and this fact constitutes another argument against their use. Though acute inflammation in general contra-indicates the use of the astringent drugs, there are a few whose employment is permissible in such cases, and nitrate of silver, acetate and subacetate of lead, and subcarbonate and subnitrate of bismuth are astringents which even in acute inflammation are often of the greatest benefit, but rather in spite of their being astringents and because they are also sedatives.

Akin to the action of the astringents in diminishing and checking *exudation* and *discharge* is their action in like manner to reduce and stop *hæmorrhage*, and what has been said of exudation applies equally well to hæmorrhage if it is internal; if it is due to relaxation and passive congestion they act beneficially, but if the hæmorrhage is symptomatic of vascular excitement and active hyperæmia they are to be avoided in general. If the hæmorrhage is from an opened vessel, however, and the application of an astringent is made directly to the part, the action of the drug is due rather to its power to coagulate the serum albumin, and thus to cause clotting and consequent plugging of the bleeding vessel, than to a pure astringent action, though this, too, is present to some extent. Applied thus and for this purpose, the drugs of the astringent class are known as styptics.

The mineral astringents have each its peculiar astringent properties and powers, and, though in the vegetable class the greatest variation and difference exist among its members as regards their astringent action, yet for this power they all depend upon the presence in them of tannic acid in some form, the form varying with the plant, but each being none the less tannic acid and therefore astringent.

To name all the drugs possessed of astringent properties would be an endless and indeed an impossible task, but the more important ones may well be mentioned, and, as usual, they are classed in the two divisions, vegetable astringents and mineral astringents. The vegetable astringents include gallic acid, tannic acid, galls, catechu, krameria, kino, geranium, grindelia, hamamelis, hæmatoxylon,

myrrh, rhus glabra, quercus alba, calendula, creosote, and sage.

The mineral astringents include alum and the aluminum salts; lead salts, especially the acetate, the subacetate, and the carbonate; the oxide, the acetate, the chloride, the carbonate, and the sulphate of zinc; bismuth subcarbonate and bismuth subnitrate; cerium oxalate; the salts of copper, particularly the sulphate; nitrate of silver; iron salts, particularly the chloride, the sulphate, and the subsulphate; the sulphate of iron and ammonium (ferric alum); the sulphocarbolates of sodium and of zinc; sulphuric acid; chalk; and lime.

Henry A. Griffin.

ATROPA BELLADONNA.—See Belladonna.

ATROPINE, the *atropina* of the U. S. and Br. Ph's., the *atropinum* of the Ger. Ph., is an alkaloid obtained from the belladonna plant, which is indigenous to Europe and Western Asia, and is cultivated to some extent in America. All parts of the plant (*Atropa belladonna*, Nat. ord. *Solanaceæ*, or *deadly nightshade*) contain the active and poisonous principle, atropine, which, indeed, is not, as it appears in commerce, a simple substance, but contains a certain admixture of hyoscyamine. The alkaloid has a strongly alkaline reaction. Uncombined, it is not used in medicine, but is represented by the sulphate (*atropinæ sulphas* [U. S. Ph., Br. Ph.], *atropinum sulfuricum* [Ger. Ph.]), which is practically neutral in its chemical reaction, a fact that probably renders its toleration by the stomach more certain, and is of great advantage in its hypodermic use, as it renders it less irritating to the tissues when it is injected into them.

Atropine is distinguished, in so far as its general action is concerned, by two somewhat remarkable peculiarities. In the first place, although it is one of the most powerful of the medicinal alkaloids, as judged by the minuteness of the dose and the alarming character of the symptoms which follow its introduction into the circulation, fatal cases of poisoning by it are comparatively of very rare occurrence, even when the outlook seems to be most desperate. The practitioner should therefore not despair when confronted by conditions which at first sight appear quite hopeless.

This peculiarity, no doubt, is due to the fact that the lethal effect comes on very slowly, thus giving time both for the employment of restorative means and for the recuperative and eliminative processes of the body to rid it of the *materia peccans* and readjust the vital mechanisms.

In the second place, atropine is remarkable in that its physiological action upon the healthy body, as determined by experiments upon man and animals, affords but a very inadequate explanation of its various therapeutical uses.

A further peculiarity of belladonna and its alkaloid is that, while they are most violent poisons to all the *Carnivora* and to omnivorous man, they are taken by the *Herbivora* and by birds (the *Gallinaceæ*, at any rate) with perfect impunity. And it may be, though I have not seen it suggested by any author, that the explanation of the apparent discrepancy between their operation physiologically and therapeutically will be found to be in some way connected with this difference between their action on *Herbivora* and on *Carnivora*. The practical character of this work will not, however, permit of the discussion of so purely theoretical a proposition.

The physiological effects of atropine and its sulphate are very striking, and peculiar to it and the other plants of the order *Solanaceæ*, viz., *stramonium* and *hyoscyamus*. Applied *externally* to the mucous membranes, atropine has a moderate anæsthetic effect, causes a contraction of the arterioles of the submucosa, with consequent diminution of swelling when any exists, an evident lessening of the blood supply, and reduction or complete suppression of the secretion of the mucous glands. Like cocaine, its primary effect is usually to increase the secretion of mucus by the contraction of the unstriped muscular fibres of the vicinity, and this is followed by well-marked dryness. Applied to the conjunctiva, it is absorbed and, acting probably upon the local neuro-muscular mechanism of the iris, causes a dilatation of the pupil with inability to contract under the influence of light. It also paralyzes the accommodation so as to induce a condition of temporary functional presbyopia.

Its anæsthetic effect renders it very serviceable in inflammatory conditions of the exterior of the eye, but in such a condition as *glaucoma*, where there is deep-seated irritation, with chronic irido-chorioiditis, further dilatation of the pupil, which would result from the local use of atropine, would, by admitting more light, increase the discomfort of the patient and aggravate the disease. This gives us an admirable illustration of the combination of beneficent qualities with the power to do harm possessed by all drugs and agents which have any great therapeutic value. Applied to the skin over *inflamed* and *swollen parts*, either when the skin itself or the subjacent tissues are painful or over-sensitive, it relieves both the pain and the tenderness, frequently to a very marked degree. This effect, which has been especially noted in cases of *cancerous tumours* and *infiltrations*, but which is equally available in the treatment of *neuralgia* and of many congestive and inflammatory conditions, is due apparently both to a direct anæsthetic action upon the terminal fibres of the sensory nerves and to the power of the drug to induce contraction in the small blood-vessels of the part. That its solution penetrates below the surface to the cutaneous or even the subcutaneous blood-vessels is demonstrated by its action on the sudoriparous glands, as well as by its producing pupillary dilatation, frequently if not usually confined to the side of the body on which the application is made.

The symptoms produced by atropine given internally are, to a considerable extent, dependent on the size of the dose. Small or moderate doses have the singular effect, in the

first place, of inducing quite generally the phenomena which follow, locally, its topical application. That is to say, the mucous membranes of the eyes, the throat, the nose, the mouth, the Eustachian tubes, and in all probability the entire alimentary tract become less moist or even dry; both pupils are dilated, visual accommodation is slightly embarrassed, the salivary secretion is diminished, and the general sensibility is lessened, although the special senses are said to be more acute than is usual. To vision, the latter statement applies only within the range of the accommodation. In addition to these effects, there is increased vigour of the cardiac action, which is sometimes slightly retarded at first, though usually accelerated. The systole is more forcible and complete, the diastole corresponding in its rhythm. The arterial pressure is somewhat increased. The skin is warm, and, particularly in children, there is a slight blush, which increases, when the dose is somewhat larger, to a well-marked erythema. The writer has, indeed, seen the skin of an infant assume the bright red of scarlatina, its appearance very closely resembling that characteristic of the disease. The peristaltic movements of the intestines are intensified. The secretion of urine is notably increased. While the details of this symptom-group are difficult of explanation, they point collectively to an impression upon that portion of the nervous system included in the medulla oblongata, the sympathetic, and the cilio-spinal region of the cord.

Large doses increase the above-mentioned symptoms, giving rise to marked dilatation of the pupil, great disturbance of vision, sometimes even so affecting the retina as to produce blindness, and to great dryness of the skin, with an erythema so intense as, at times, to be followed by slight desquamation, together with complete dryness of the mouth and throat, so as to alter the quality of the voice and make speaking difficult. The action of the heart, however, while increasing in frequency, diminishes in force, the arterial tension is subnormal, and the pulse is weak and its rhythm disturbed. As the vascular pressure falls the skin loses its warmth, its colour fades, and, if the dose proves to be lethal, or if that result is threatened, the skin may finally present the clammy sweat of approaching dissolution. With the advent of these symptoms of excessive dosing come also psychical disturbances. At first there is a mild and happy delirium, accompanied by hallucinations or spectral illusions of a pleasant nature. The patient sees flowers on his bed, upon the walls, or about the room, seeks to catch imaginary butterflies or other insects of gay and pleasing colours; or the real objects in his vicinity are presented to his consciousness as illusionary things of many varieties. At times, however, when the poisoning is more serious, the hallucinations take more disagreeable shapes, or the victim is haunted by horrid and fantastic forms and the delirium of terror may take the place of the less distressing mental disturbances usually observed. It is, however, always an active delirium, resembling the maniacal type. The respiration, also, becomes feeble, superficial, rapid, and irregular. By this disturbance of the respiratory movements and the weakened action of the heart and arteries there is caused a distinct passive congestion of the lungs and encephalon.

Corresponding to these changes we find, *post mortem*, distention of the right heart, with the above-mentioned passive hyperæmia of the brain and lungs, as well as of the abdominal viscera.

It should also be mentioned that, in fatal cases of poisoning by belladonna or atropine, towards the end the urine, previously very abundant, may be greatly diminished or suppressed, owing to the fall of the vascular pressure, and coincidently with the other evidences of a lethal dose having been taken.

Therapeutically, the uses of atropine are many and mostly well defined. It may, indeed, be said of atropine that the indications for its employment are peculiarly distinct. It is one of the drugs which seldom are, as they certainly never should be, given at random.

As regards its *external application*, its therapeutic points have been largely touched upon in what has been said above of its physiological action.

As regards its employment in *diseases of the eye* and its associated parts, I shall give here only the indications which may guide the general practitioner in its use. In the first place, it is of use in all the superficial inflammatory conditions, accompanied by pain, ordinary tenderness, and photophobia.

In the *ulcerations* and *phlyclænular conditions of the cornea* so often met with in strumous and anæmic children, and also, though less frequently, in adults, the instillation of a few drops of a weak solution (1 grain to 1 oz.) two or three times daily is productive of the greatest relief. Again, in *iritis*, particularly of the syphilitic variety, which is always prone to be followed by synechiæ, or adhesions of the iris, either posteriorly to the capsule of the lens or anteriorly to the cornea, the early dilatation of the pupil is a matter never to be neglected.

For this purpose a stronger solution must be employed (from 2 to 3 grains to 1 oz.), and at the beginning of the treatment it should be applied often enough to secure rapid and thorough dilatation, thus removing the iris from the more protuberant part of the lens, where it is most likely to adhere. The *photophobia* of acute conjunctivitis, as well as that accompanying the chronic form, particularly when the latter is associated with *blepharitis* and *granular lids*, is relieved by mild solutions not too frequently applied. The simplest method of instillation is to have the patient's head well thrown back, and, while the eye is gently closed, to drop a little of the solution into the slight depression at the inner canthus, then immediately draw the lower lid downward so as to allow the fluid to flow into the inferior sulcus of the lids. This is most easily accomplished if the end of the thumb is placed on the lower lid near the inner canthus, while

the skin is yet dry, ready to depress the lid the moment the liquid is dropped in. The latter then flows easily into the lacus lacrimalis.

This little manœuvre is much more difficult of execution if the thumb or finger is not applied to the lid until after it has become wet and slippery. When the ocular disease is of a more serious or deep-seated nature—*e. g.*, *glaucoma*—the question of the treatment should be left to the decision of an ophthalmologist, as it is possible, by the effect of so powerful an agent upon the ciliary muscle or the deeper circulation and the intra-ocular pressure, to do much harm if it is not used with the greatest skill and judgment.

Neuralgia, and especially *neuralgia of the trigeminus*, is sometimes very perceptibly relieved by atropine applied externally. The writer learned from Dr. John L. Zabriskie, of Flatbush, the great utility of instilling a solution of atropine or morphine into the eye in some cases of infra-orbital neuralgia. The first instance in which Dr. Zabriskie used such a solution for this purpose occurred in a member of his own family who was at the time under the writer's care for a catarrhal inflammation extending from the nasal cavity into the antrum of Highmore, and producing a most intense neuralgia. Dr. Zabriskie thought of giving relief by the instillation of a solution of morphine and atropine into the eye, hoping that its passage through the nasal duct would bring it into sufficient proximity to the nasal and superior dental branches of the infra-orbital nerve to have some effect upon the terrific pain. The result was almost magical in appearance, the relief being very rapid and almost complete. Since then further experiences have furnished cumulative evidence of the great value of this method of treatment. In *earache*, also, the instillation of a solution of atropine is frequently quite effective in relieving the pain when the drum membrane is not pressed upon by pus in the tympanic cavity. But the simple application of a solution or ointment of sulphate of atropine to such painful parts is often followed by relief more or less prompt and more or less enduring. As mentioned above, in speaking of its physiological action, the same external use is feasible in the treatment of *erythematous dermatitis*, *erysipelas simplex*, and various painful congestions and swellings. Its employment, usually in the form of belladonna ointment, in obstetric practice will be alluded to in the article on BELLADONNA. When, after childbirth, or indeed at any other time, the *mammary glands* are *swollen* or tender, belladonna or atropine, judiciously used, is capable of affording great comfort by relaxing the tension which results from swelling, by diminishing the weight of the glands, and by its direct anæsthetic influence on the sensory nerves. In such cases, a solution of from 2 to 4 grains of sulphate of atropine in 1 oz. of water, painted on with a camel's-hair brush after the skin has been cleansed as thoroughly as possible of sebaceous matter and allowed to dry, is far better than the use of belladonna ointment, because the latter often irritates the skin, and the itching and burning resulting from its presence may, as far as the sensations of the patient go, outweigh the benefit to the original disease. And we should not forget that superficial irritation may actually add fuel to the flame when there is any hyperæmic condition of the derma or the subjacent tissues; and in an organ so easily affected by general nervous or psychical perturbation as the mammary gland the loss of sleep and the annoyance from such a surface irritation may of themselves do harm. But where the skin is firmer, as on the face, or the affected nerve, for instance, the sciatic, is deeply seated, counter-irritation is *per se* of value. It is, further, important to remember that in making such applications to the breast, the nipple and its areola should be carefully avoided.

Hypodermically, sulphate of atropine is employed for both its local and its constitutional effects. Locally, it is more frequently used in the treatment of *sciatica*, and for that purpose it is usually combined with morphine. This combination is serviceable for the diminution of pain, and sometimes effects its entire removal, and it is the opinion of many good practitioners that its efficient use in this manner often has a decided curative effect.

For its *general*, or *systemic*, effects the hypodermic injection of atropine is resorted to only in emergencies, first, as an antidote to other poisons; secondly, to stimulate the heart and overcome the great fall of the arterial pressure which occurs in serious *collapse*, *cardiac syncope*, *sunstroke*, and the dangerous exhaustion following upon the colliquative discharges and internal hæmorrhages of serious constitutional maladies. It is also effective in arresting *too copious perspiration*, whether this results from disease or from the action of drugs, such as pilocarpine, opium, alcohol, and other diaphoretics.

As to atropine in the treatment of *opium poisoning* there is some difference of opinion, but the weight of authority—for instance, that of Johnson, of Shanghai, who testifies to its curative effects in over one hundred cases—is in its favour. It is probable that the unfortunate results observed by some have been due to the employment of too large doses. Dr. Harley's experiments seem to indicate that it should be employed in opium intoxication just as in the conditions of collapse and exhaustion mentioned above—*i. e.*, in doses sufficient to stimulate the circulatory and respiratory functions, incidentally increasing the secretion of urine and so helping to eliminate the poison. The hypodermic dose for this purpose would be from $\frac{1}{80}$ to $\frac{1}{60}$ of a grain, repeated every hour or two, according to the gravity of the case and the responsiveness of the nervous tissues. The same may be said of the treatment of *poisoning by Calabar bean*, for which it is also and more decidedly an antidote. In the treatment of the *collapse* of fevers, sunstroke, etc., the dose may, perhaps, be somewhat smaller, and its combination with morphine is usually valuable. This, of course, is but one phase of the treatment of such conditions, the hypodermic phase, and does not exclude, by any means, the use of any or all other rational modes.

Internally, atropine is employed in the treatment of many diseases, some of which will be more fully considered in the article on Belladonna, which should be read in connection with this. It should be observed that the conditions for the treatment of which I have recommended the hypodermic use of atropine might be equally susceptible to its action when administered by the stomach, were it not that in them we must be sure of *speedy* and *certain* results, provided the tissues have still sufficient vitality to respond to it. But where there is time and there is a reasonable assurance of its retention and absorption, it may with equal propriety be given *per os* or, it may be, *per rectum*. But there are times when, as Dr. Schumacher has so exhaustively shown, certainty can only be secured by placing the drug under the skin, whence it has only one means of escape, and that is by absorption into the circulation. Besides its stimulating action upon the circulation, respiration, etc., atropine is to be considered in the treatment of spasmodic diseases generally. These will, however, be mentioned in the article on Belladonna. The treatment of poisoning by atropine will also be studied under the same head.

[The *liquor atropinæ sulphatis* of the Br. Ph. is a 1-per-cent. solution of atropine sulphate in camphor water. The dose is set down as from 1 to 4 minims. The discs of atropine, *lametlæ atropinæ* (Br. Ph.), are discs of gelatin, with a little glycerin, each containing $\frac{1}{5000}$ of a grain of atropine sulphate. They are to be dissolved at the time of using them. Atropine valerianate, *valeras atropinus* (*sic*), is official in the Fr. Cod. Atropine salicylate, which is not official, is said to keep better in solution than the other salts of atropine.]

Benjamin F. Westbrook.

AURAMINE.—Yellow pyoctanin.

AURANTIUM.—Under this name are included the preparations having as their bases the leaves, fruit, and flowers of the bitter and sweet orange-trees. The active principle of all of them is an essential oil of an agreeable odour, possessing carminative and feebly stimulating properties. This oil exists in considerable quantities in the peel of both the bitter and the sweet orange. In excessive doses it is narcotic and irritant, causing nausea, vomiting, dyspepsia, confusion of the mind, and loss of muscular power. Externally, it is a decided irritant to the skin, giving rise to erythematous and papular eruptions.

In tropical and semitropical countries a weak infusion of the leaves is a popular domestic remedy in the first stage of yellow fever, but is of little value for this purpose, except perhaps in preventing the use of something else that might prove harmful. From the peel of the sweet orange are made a confection and syrup, of agreeable taste, used to disguise bitter and acrid drugs. The dried peel itself stimulates the digestion somewhat and is mildly carminative. From the peel of the bitter orange is made an official tincture of which the dose is 1 to 2 fl. drachms, used as a carminative and digestive tonic and as a vehicle for medicines whose taste it is desirable to disguise. It forms an agreeable base for mixtures containing the bitter tonics. The fresh flowers furnish orange-flower water, from which a syrup is prepared. Both the water and the syrup are used for flavouring purposes and as sedatives for impressible persons affected with headache, palpitation of the heart, or some mild functional nervous disorder. The essential oil distilled from the flowers of both the bitter and the sweet orange is known as oil of néroli, and that from the flowers of the bergamot orange as oil of bergamot. Both have slight stimulating properties, but are little used except for scenting ointments and in the perfumer's art. The juice of oranges is highly efficient in a condition very closely resembling *scurry*, sometimes found in infants who are fed on improper food.

In the following account of preparations the dried peel is meant unless the fresh peel is mentioned: From the bitter peel, *aurantii amari cortex*, the U. S. Ph. orders a fluid extract, *extractum aurantii amari fluidum*, made by extracting 1,000 grammes of it with a sufficient quantity of equal parts of water and alcohol to make 1,000 c. c., and a tincture, *tinctura aurantii amari*, which contains 1 part in 5, the doses of which should not exceed a drachm; from the sweet peel is made a tincture, *tinctura aurantii dulcis*, of the same strength and dose as that from the bitter, and a syrup, *syrupus aurantii*, used as a vehicle; from the flowers of the sweet and bitter orange-trees is distilled the stronger orange-flower water, *aqua aurantii florum fortior* (U. S. Ph.), *aqua aurantii floris* (Br. Ph.), *hydrolatum floris citri aurantii* (Fr. Cod.), which, diluted with an equal bulk of distilled water, constitutes the orange-flower water, *aqua aurantii florum*, of the U. S. Ph. The peels of both varieties form an unimportant constituent of a large number of mixtures containing drugs whose taste it is desired to conceal. The Ger. Ph. directs a tincture and a syrup similar to those of the U. S. Ph. An infusion, *infusum aurantii*, of 1 part in 20, a compound infusion, *infusum aurantii compositum*, of 1 part in 40, and a tincture, *tinctura aurantii*, of 1 part in 10, are ordered by the Br. Ph. to be made from the dried peel of the bitter orange, *aurantii cortex*; and from the fresh bitter peel a tincture, *tinctura aurantii recentis*, of 1 part in 6, of which the dose is from 1 to 2 fl. drachms.

Russell H. Nevins.

AURUM.—See Gold.

AVA.—See Kava.

AVENA.—See Oatmeal.

AXEROMATICON is a trade name for a powder, said to consist of finely ground rice, tinted of a delicate rose-colour with carmin and perfumed with oil of lemon, for rubbing on the hands to palliate *hyperidrosis*.

AXUNGIA.—See Lard.

AYA-PANA.—The leaves of this tropical species of *eupatorium* are used as a *diaphoretic* in doses of from 15 to 45 grains, twice a day.

AZEDERACH.—This is the root-bark of *Melia Azederach*, a native of Asia, now naturalized in the Southern United States, where it is known as the pride of China or of India. In excessive doses it is reputed to cause giddiness, dimness of vision, vomiting and purging, and a condition approaching collapse. It is used almost exclusively as an *anthelminthic* in cases of *lumbricoid worms*. As its properties are quickly lost after it is gathered, its use is almost entirely confined to the localities in which the tree grows. The commonest preparation is a decoction made by slowly boiling 2 drachms of the fresh bark in a pint of water until the bulk is reduced one half. Of this a tablespoonful is to be given every three hours until five or six doses have been taken, after which a cathartic is administered unless it acts as such by itself. Another plan is to give a tablespoonful night and morning for three or four days, but the former plan is the better. A fluid extract, a tincture, and a syrup are made, of which the doses are from 30 to 120 drops, and they are used in the same manner as the decoction.

In domestic medicine azederach has a slight reputation as a tonic, but is rarely used as such. The leaves are effectual in the treatment of *bots* in horses, but seem to be entirely harmless to man, and the fresh bark and fruit are reported to have the same effect as the root-bark. Birds have been said to be intoxicated by eating the berries, but more careful observation has shown that they simply become gorged and stupid by the excessive amount they eat.—Russell H. Nevins.

AZOTE.—See Nitrogen.

BACILLI.—In pharmacy, these are preparations having a cylindrical form, such as sticks of caustic, pastilles, and crayons, pencils, or bougies for insertion into sinuses or into the natural passages of the body. (See Pencils.)

BACTERIOTHERAPY.—The term bacteriotherapy is used to designate a plan of treating disease due to some specific micro-organism by employing some other micro-organism to destroy it. The first to suggest making use of the antagonism between micro-organisms was Professor von Pettenkofer, in an address before the Society of German Naturalists and Physicians in 1881, when he expressed the view that in places infected with cholera the porous soil, open to the reception of diarrhœal filth, permitted of the easy diffusion of the specific organism of cholera by underground water-currents; but that there were some places in which the soil was occupied by benign bacteria to such a degree as to render that soil sterile to noxious bacteria when introduced from without. Therefore von Pettenkofer considered it would not be surprising if in future times the useful bacteria were actually cultivated and domesticated in the soil under our houses, so that the supply of organic matter might be exhausted and pathogenic organisms starved out or destroyed by the non-pathogenic bacteria.

Laboratory research has shown that micro-organisms, like more highly organized beings, have a struggle for existence, and that one organism growing in a culture fluid will often destroy another that is introduced into it. Dr. C. Garré, of Basel, while investigating the antagonism of bacteria, found that some aerobes that spread only on the surface of gelatin so altered the nutritive substratum in a short time that certain other organisms could not exist in it. He found that the *Bacillus fluorescens putridus* of Flügge was pre-eminently antagonistic, as it excreted specific substances easily diffusible, the oxidation products of which tinged the gelatin with a greenish colour and hindered the development of various other species. For example, the *Staphylococcus pyogenes aureus*, the typhoid bacillus, and the pneumococcus would not grow on a medium on which the *Bacillus fluorescens* had been grown, though this same medium was a suitable soil for the slow growth of the comma bacillus of Asiatic cholera, or the luxuriant growth of the *Bacillus anthracis* and other varieties of the comma bacillus. Garré found that the reverse of these experiments did not hold good. He showed that there were symbiotic bacteria, those that flourished side by side, and even metabiotic bacteria whose existence depended upon the presence of other organisms. He concluded that immunity from a certain disease might be caused not only by inoculation with micro-organisms of like species, but perhaps with entirely different microbes.

This latter idea had been practically tested by Professor Arnaldo Cantani, of Naples, who attempted clinically to destroy a pathogenic bacillus by favouring the introduction of a non-pathogenic hostile micro-organism, and thus to check *tuberculosis*. Having found that the *Bacterium termo* often prevented the growth and development of the *Bacillus tuberculosis*, he proceeded to determine the innocuousness of the first-named organism by the inoculation of animals. He then treated a woman, aged forty-two, who had signs of a large cavity in the left lung and whose sputa contained tubercle bacilli, with daily inhalations of liquefied gelatin diluted with meat-broth and containing a rich culture of *Bacterium termo*. He reported that the expectoration rapidly diminished and ceased altogether, and the tubercle bacilli were decreasing in number and being replaced by the *Bacterium termo*. After this, inoculation of animals with the patient's sputum failed to produce tuberculosis. Cantani did not maintain that the *Bacterium termo* was more inimical to the *Bacillus tuberculosis* than any other organism, but wished to direct attention to a suggestive plan of treatment.

Subsequently Dr. Salama, of Pisa, reported the history of a tuberculous patient treated with inhalations of *Bacterium termo*. In two weeks the tubercle bacillus had disappeared from the sputum and the patient had improved in every way.

Dr. Filipovitch, of Odessa, treated six cases of advanced pulmonary tuberculosis with inhalations of a solution consisting of 5 c. c. of

a pure culture of *Bacterium termo* diluted with 10 c. c. of boiled water and a few drops of tincture of peppermint to disguise the offensive odour. The inhalations were repeated twice daily, but none of the patients were benefited by them. He did not find that the bacteria diminished or disappeared during the treatment. Sormani, Ballagi, and Stacklevicz confirmed this experience.

On the other hand, Mr. A. Primrose Wells reported five cases of tuberculosis treated by inhalations three times a day of 2 oz. of a pure cultivation of *Bacterium termo* in meat infusion, the patient taking deep inspirations during the inhalations. Permanent improvement had resulted in two cases. This observer considers the inhalations useless in rapidly developing tuberculosis or where an excavation exists.

Dr. A. D. Pawlowski pointed out in a paper published in Virchow's *Archiv* (cviii, 1887, p. 494) that one great error of Cantani's method was the obvious confounding of many species of bacteria under the head of *Bacterium termo;* another error was the reliance on the antagonism of the *Bacterium termo* and the tubercle bacillus as sufficient to cause the destruction of the latter. Pawlowski's experiments demonstrated that it was in no such direct way that one micro-organism could be made to counteract the effects of another.

Emmerich reported in 1886 that when animals were inoculated with anthrax bacilli and with erysipelas cocci, either simultaneously or at a short interval, the result was either a prolongation of life beyond the period at which the anthrax bacillus usually caused death, or even a complete neutralization of the anthrax virus and the recovery of the animal. Pawlowski reviewed these experiments and, in addition, experimented on the counteracting influence of the *Bacillus prodigiosus*, *Staphylococcus aureus*, and *Diplococcus pneumoniæ* to that of the *Bacillus anthracis*. The cultures were injected, subcutaneously or intravenously, either at short intervals or simultaneously, and it was found that local anthrax could be cured by the subcutaneous injection of these micro-organisms, the *Diplococcus pneumoniæ* being the most powerful antagonist of the anthrax bacillus, the *Staphylococcus aureus* next in efficacy, the *Bacillus prodigiosus* less antagonistic, and the *Streptococcus erysipelatos* least efficacious. Intravenous injections failed to produce as good results as subcutaneous injections did, and by the use of the *Staphylococcus aureus* pyæmia was sometimes produced.

Pawlowski considered that the effect of these injections was due to the phagocytes being stimulated to increased resistance, as well as re-enforced in number, so that they were better able to resist the intrusion of the anthrax bacilli.

More recent investigations have indicated that, rather than the particular micro-organism, it is the toxine that is efficacious in overcoming disease. As yet it is not known whether there is a specific organism of cow-pox, though, if there is, it serves to render the vaccinated subject an unsuitable field for the development of small-pox, while vaccination performed after the appearance of small-pox in the person does not modify the disease.

The subject of erysipelas inoculation, a form of bacteriotherapy, in the treatment of cancer is discussed elsewhere in this work. (See also SERUM THERAPY.)—SAMUEL T. ARMSTRONG.

BAEL FRUIT.—See BELA.

BAFFINE is a proprietary preparation said to be a 2-per-cent. solution of potassium permanganate.

BALNEOTHERAPEUTICS.—See under BATHS.

BALSAMICS, BALSAMS.—Though balsam of Peru (*balsamum peruvianum*), balsam of Tolu (*balsamum tolutanum*), and storax (*styrax*) are the only balsams recognised as such by the U. S. Ph., there are a great many unofficial balsams, many of them indeed improperly so called and many of them simply artificial mixtures of oils and resins. Copaiba has long been known by its synonym, balsam of copaiba, and so has Canada turpentine by that of Canada balsam, yet the former is, according to the U. S. Ph., an oleo-resin and the latter a liquid oleo-resin. Benzoin, too, though essentially a balsam, is described by the U. S. Ph. as a balsamic resin. Friar's balsam is an old name for compound tincture of benzoin.

Technically, this preciseness and accuracy of classification are called for, but from the clinical and therapeutical standpoint they are not, for mainly on the presence of a volatile oil does the therapeutic action of balsams, balsamic resins, gum-resins, and oleo-resins depend, regardless of the combination in which it is found. Balsamics, then, while they have each its special therapeutic efficiency and consequently each its practical or clinical application, have in common most decided characteristics which depend, as has been said, mainly upon the presence of volatile oils in them.

An *antiseptic* property is a marked attribute of the balsamics. Though to a greater or lesser degree present in them all, it is especially seen in balsam of Peru, the use of which as a surgical dressing is exceedingly common. Benzoin, too, is possessed of considerable antiseptic powers, both when used as an external application and when given internally in the form of benzoic acid or one of its salts. This power of benzoin as an *intestinal antiseptic* is considerable, and, though this would seem to be the limit of its effectiveness, there are many who firmly believe in the administration of benzoate of sodium as an antizymotic in *general sepsis* and *infectious diseases*.

A *local stimulant* action is possessed by all the balsamics, and in greater or lesser degree they act to promote the activity of the surfaces to which they are applied. This action of local stimulation is especially seen in the case of balsam of Peru, which, when applied to a sluggishly granulating wound, acts to promote a healthier and more active granulation and healing. To some degree balsamics, taken internally, all act to cause diaphoresis, diuresis, and increased bronchial secretion, and to a slighter though appreciable extent intestinal

secretion also is stimulated, while in the case of many of them there is a special activity upon the genito-urinary tract. Each, while acting to some extent upon all these surfaces, is possessed of a more marked activity manifested in one of these localities in particular. Thus there are the special action of balsam of Tolu as a stimulating expectorant and the marked effect of balsam of copaiba and benzoin upon the genito-urinary tract.

Akin to the antiseptic properties of the balsams is the power possessed by some of them to act as *antiparasitics*. This power is especially marked in the cases of storax and balsam of Peru, and in *scabies* their employment is of the greatest service.

Occasionally the balsamics are used to stimulate to healthy action the intestinal mucous membrane when it is the seat of *atonic catarrhal inflammation*. Most of them have been used for this purpose from time to time, but benzoin is by far the most effective, and its use in *chronic catarrhal colitis* is at times extremely beneficial.

Canada balsam finds constant employment in the mounting of microscopic specimens, an application which is due to its adhesive qualities and its characteristic of drying in a clear, transparent, and structureless form.

Henry A. Griffin.

BANTINGISM.—A method for the reduction of *corpulency*, so called from a British merchant, named Banting, who published a pamphlet giving a dietary adopted by him under the directions of his medical adviser. There is nothing particularly novel in his plan of treatment beyond the manner in which it was presented to the public. For a time it was the fashion for those of a fatty habit to follow it out with the various modifications suggested by individual taste.

Mr. Banting seems to have received considerable advantage from his course, as he reduced his weight forty-six pounds in the course of a few months and obtained a decided improvement in his general condition. For breakfast, at 9 A. M., he allowed from 5 to 6 oz. of lean meat, pork and veal excepted, or an equivalent amount of broiled fish (salmon, herring, and eels excepted), one cup of tea or of coffee without milk or sugar, 1 oz. of dry toast, and a little biscuit (crackers); at 2 P. M., 5 or 6 oz. of fish, meat, poultry, or game, with the exceptions noted above in each case, 1 oz. of dry toast, vegetables (except potatoes, parsnips, beets, and carrots), unsweetened fruit, and two or three glasses of claret or Madeira, malt and all other alcoholic liquors being forbidden; at 6 P. M., 2 or 3 oz. of cooked fruit, one cup of tea without milk or sugar, and one or two rusks; and at 9 P. M. from 3 to 4 oz. of meat or fish and a small quantity of claret or sherry. The total amount of solid food in this dietary is from 21 to 27 oz., and that of fluids about 35 oz.—amounts entirely insufficient to maintain the organism in a healthy condition. The alcohol in the wines allowed is entirely out of place in any plan of diet to reduce obesity, as it is one of the most marked fat-producers which can be found. The evil effects of this course of treatment were shown by the occurrence of albuminuria in many cases and a most painful craving for water and fatty articles of food in all cases. The danger of albuminuria is so great that the warmest advocates of this dietary advised frequent examinations of the urine to ascertain its presence. The reduction of adiposity, except where it is pathological, rests almost entirely in the hands of the individual and depends more upon proper amounts of exercise and proper hygienic surroundings than upon any precise regulation of the diet. If it were not so, the races which live almost exclusively upon the carbohydrates and fatty foods—such, for example, as the Italians and Spaniards—would be the most distinguished for their obesity, which is well known not to be the case. The negroes in the Southern States have little in the shape of food except bacon, maize-meal, hominy, and syrup, and do not take on any great amount of fat. Bantingism as Mr. Banting presented it to the public no longer exists, and in all dietaries having his end in view we must allow sufficient fats, carbohydrates, and fluids to supply the natural waste of the system, and to prevent craving for them.

Russell H. Nevins.

BAPTISIA TINCTORIA, or *Sophora tinctoria*, wild indigo, is a North American papilionaceous plant. The root contains *baptisin*, a resin that has been used as a tonic, a laxative, and an emetic; *baptin*, a purgative glucoside; and *baptitoxine*, a violently poisonous alkaloid said to act like curare. The plant is not official. A fluid extract is used in doses of from 10 to 20 drops as a purgative and cholagogue, and for the same purposes a tincture in doses of from 20 to 30 drops. *Baptisin*, obtained by precipitating the tincture with water, appears to be the active medicinal principle of the plant. It is given in doses of from 0·385 of a grain to $1\frac{1}{2}$ grain. It is said to have caused abortion. Great caution should be observed in its employment.

BARDANA.—See Lappa.

BARIUM.—The metal itself has no medicinal use. The barium salts have a stimulating effect on the ventricles of the heart; applied locally to a muscle, they cause it to describe a curve in which there are an increase and a prolongation of the contraction, and a slow descent. The contraction is enormous, but it is not so well marked when the drug is injected into the circulation as when it is applied to the muscles. This action is diminished, and even removed, by heat or cold, and it temporarily disappears after repeated contractions. Barium is therefore a muscle poison only under certain conditions of temperature and when certain amounts are used. In moderate doses, these salts cause contraction of the blood-vessels and stimulation of the cardiac muscle, as is shown by increased energy of its contraction, though the pulse-rate remains the same.

Boehm's experiments with the acetate, chloride, and nitrate demonstrated that the effect was due to the base, and that the varying influence of the several compounds was owing only to

the difference of their solubility. In mammals the activity of the heart is terminated in systolic arrest of the left ventricle. It is doubtful whether the diminution in calibre of the small arteries is due to nervous action or to a direct action by the salt on the muscular tissue. The inhibitory endings of the vagus are paralyzed, there are respiratory disturbances of central origin, and asphyxia is secondary to cardiac paralysis. There are gastro-intestinal symptoms (diarrhœa and vomiting) that are due to a marked increase in the activity of the hollow viscera. Boehm concluded that either the whole sympathetic system was decidedly affected, or these salts specifically and generally affected unstriped muscular tissue. Subsequent investigations have shown that the latter is the case.

The oxides and hydrates, on account of their alkalinity, are corrosive poisons. All the soluble barium salts are actively poisonous.

Barium bromide.—See under Bromine.

Barium carbonate, $BaCO_3$, or *witherite*, is used to prepare barium chloride. The carbonate is a poison, and in an instance in which it had been used to adulterate flour four persons were poisoned. The symptoms were vomiting, diarrhœa, malaise, a feeling of tightness of the skin, and weakness, especially in the lower limbs. One of the four, an old man, had paralysis of the lower legs on the day succeeding the poisoning and died the same night. The necropsy showed only a dark colour of the grey substance of the brain.

Barium chloride, *barium chloratum*, $BaCl_2(H_2O)_2$, is obtained by treating barium carbonate with hydrochloric acid; or barium sulphide is first produced by heating barium sulphate with charcoal, and it is then decomposed in a watery solution by adding hydrochloric acid. The salt is a white, soluble, crystalline substance that has a bitter, disagreeable taste.

The investigations made by Dr. Sidney Ringer and Dr. Harrington Sainsbury into the physiological action of barium chloride showed that the salt increased the blood-pressure, retarded the pulse-rate, and arrested the heart in systole. This systolic arrest of the heart and retardation occur also when the centres of reflex control are destroyed. The salt applied to the heart, *in situ*, produces local spasm at the point of application, and the excised heart is found arrested in full systole. If the central nervous control of the blood-vessels is destroyed, the vessels still respond to the direct action of the salt, and without this direct local action the calibre of the vessels is uninfluenced.

Dr. A. Bary, Dr. Kobert, and Dr. H. A. Hare confirm these observations, and they agree that barium chloride slows the heart very greatly, steadies its rhythm, and at the same time increases the volume of blood thrown out of the ventricle. In fact, Bary's experiments showed that barium was very similar in action to digitalis and somewhat less to physostigmine. The arrest of the heart's action produced by muscarine or chloral was prevented by using this salt.

There are a number of recorded fatal cases of *barium poisoning* following the administration of the chloride. Recently Dr. A. Pilliet and Dr. A. Molbec made a series of experiments, administering it to dogs subcutaneously in doses of 1 centigramme for every kilogramme of the dog's weight, and death occurred in twenty-four hours. With less powerful doses the animals lived longer. The toxic symptoms were persistent vomiting, diarrhœa, albuminuria and hæmoglobinuria, and convulsions followed by rigidity. Post-mortem examination showed that the glomeruli of the kidneys were especially affected, and there were hæmorrhages in the straight tubes. Similar symptoms are produced in man by toxic doses. The treatment consists in the free administration of the soluble sulphates, such as those of sodium and magnesium, after the stomach has been thoroughly emptied of its contents.

Dr. A. Crawford, in 1789, recommended barium chloride as an efficient remedy in *scrofula*, and reported a number of cases cured by its administration. Scassi, Mojon, Mongiardi, and Ferrari, in Italy, and Lisfranc, in France, corroborated this report. Lisfranc considered it particularly valuable in *white swelling* in children, notwithstanding the sensation of weight in the stomach and sometimes of nausea that its administration produced; he also noted that it reduced the frequency of the pulse from between 60 and 80 to between 40 and 50, and even to 25. More recently that excellent clinician, Dr. J. Walsh, has said that there are some cases of scrofula in which iodine is useless, but considerable benefit may be derived from taking barium chloride, and that the barium salt is useful also in those cases in which iodine is valuable to a certain point, beyond which, if persisted in, its beneficent action ceases. These authors administered the salt in aqueous solution, in doses of from $\frac{1}{8}$ to $\frac{1}{15}$ of a grain every two or four hours. With the change in our knowledge regarding the ætiology of the so-called scrofulous diseases, it is not apparent in what manner this salt can exercise a therapeutic effect, yet these clinicians agree regarding its value as a remedial agent if taken for from three to four months.

It may be used in the various forms of *cardiac disease* in which there is failure of the heart muscle. Da Costa found that in *valvular disease of the heart* it was both a general and a cardiac tonic, diminishing and relieving cardiac distress, increasing the tone in the blood-vessels, and producing diuresis; also that it was a remedy that could be taken for a long time without disordering the stomach.

Dr. H. A. Hare has found that in cases of *functional cardiac disorder* barium chloride brings about rapid improvement. He states that, while the volume of the pulse is increased, it does not give that sensation of tenseness to the finger that digitalis causes it to give, and that the sphygmograph shows the pulse waves to be prolonged.

Dr. W. A. Hammond has used it with benefit in *diffuse and multiple cerebral sclerosis*. Brown-Séquard stated that it was of real value in the treatment of *tetanus* (tetany, perhaps)

and *paralysis agitans*, but that it was useless in the treatment of *epilepsy*.

It has been administered in various *cutaneous diseases;* and in doses of $\frac{1}{5}$ of a grain three times a day it is said to cure the irritable forms of *dry eczema* after arsenic has failed. Mineral waters containing barium salts have long enjoyed a reputation for efficacy in skin diseases.

Barium chloride has been applied, in ointment, to *varicose veins* in order to produce contraction of the vessels, but no effect has followed this use of it.

The dose is from $\frac{1}{5}$ to 1 grain, dissolved in a large quantity of water and taken some hours after meals.

Barium dioxide, *peroxide*, or *hyperoxide*, the *barium dioxidum* of the U.S. Ph., is prepared by heating barium oxide to about 450° C., when it takes up another atom of oxygen. It is a greyish-white, amorphous solid that is gradually decomposed on exposure to air. It is not used medicinally, but has been introduced into the pharmacopœia because it is used in making hydrogen dioxide.

Barium iodide.—See under Iodine.

Barium oxide, *baryta*, BaO, is prepared by calcining barium nitrate or by igniting the carbonate or sulphate with charcoal. It is a greyish-white, amorphous, caustic solid. Exposed to the air, it absorbs moisture and carbon dioxide. It is used in the preparation of barium dioxide, but has no medicinal use.

Barium sulphide, BaS, is a white powder. It has been used as a *depilatory*, according to the following formula:

℞ Barium sulphide, powdered, 1 to 3 parts;
Starch powder............ 3 parts.

Make into a cream with water and spread it on the affected skin; allow it to remain from five to ten minutes, then remove it with a blunt knife.

Barium sulphocarbolate, $Ba(C_6H_5SO_4)_2$, is prepared by digesting an aqueous solution of the latter with barium carbonate. Its physiological action has not been investigated. It has been used in *colliquative diarrhœa* in rhachitic children and in *gastro-intestinal disturbances.* The dose is from $\frac{1}{4}$ to 1 grain, in water, several times a day.—Samuel T. Armstrong.

BARLEY.—See Hordeum.

BAROSMA.—See Buchu.

BARYTA.—See *Barium oxide*, under Barium.

BARYUM.—See Barium.

BASILICON OINTMENT. — Ceratum resinæ.

BATHS have been employed for therapeutic purposes since the dawn of history. The *Rig-Veda* says:

Healing are the watery billows, water cools the fever's glow,
Healing against every plague, health to thee brings water's flow.

While the early medical writings of the Hindus, Chinese, Egyptians, Greeks, and Romans contain references regarding the employment of hydrotherapy, it was among the Romans that baths attained their greatest elaboration. On entering an establishment the bather found himself in the *apodyterium*, which served for disrobing apartments; then the bather entered the *tepidarium*, in which dry hot air was maintained at a fixed temperature; then he passed to a chamber, the *calidarium*, in which the temperature was more elevated; thence he was sent to the *alipterium* or hall for massage, and then to the *lavatorium*, where he received ablutions of tepid water; and finally to the *unctorium*, where he was rubbed with ointments and perfumes. There were other apartments, such as the *vasarium*, a chamber in which there were three basins, placed one above another, that supplied hot, tepid, or cold water according to their distance from the hot-air chamber. The *balneum* contained a pool, the *alveus*, upon the border of which or on benches (*solia*) the bathers seated themselves. In the *frigidarium* the bather might be cooled off by sprinkling from a tub or by a cold bath. The invention of the *balnea pensilia*, or shower baths, was ascribed to Asclepiades. While Hippocrates had advised tepid baths in the treatment of fevers and pneumonia, it was reserved for Asclepiades, Charmis of Marseilles, Agathinus, Celsus, Musa, and Aretæus to indicate the more general application of baths in the treatment of disease, and so popular did hydrotherapy become and so pronounced were its friends and foes that in the time of Galen the medical profession of Rome was divided into two sects, the *hydrophiles* and the *hydrophobes.* The former were subdivided into the *thermophiles*, who preferred hot water, the *psychrophiles*, who preferred cool water, the *psychrolites*, who preferred cold water, the *psychropaths*, who administered cold drinks, and the *psychropants*, who embraced both the last-named methods.

During the early centuries of the Christian era the Arabian physicians recommended cold baths in the treatment of measles and smallpox, though Avicenna regulated his employment of this method by the patient's age and constitution and the season of the year.

In the fifteenth century Michael Savonarola, Mengo Bianchelli, and Christoforo Barzizi in Italy revived the subject of the therapeutic employment of cold baths. At the end of the seventeenth century Sir John Floyer wrote his work *Psychrolusia*, in which he recommended the use of cold baths, and Bartholini and Diembröch in Germany employed baths in the treatment of a number of diseases.

In the eighteenth century Friedrich Hoffmann wrote a book to demonstrate the utility of water in all diseases, either acute or chronic. From this period on, the history of the use of baths is so associated with that of *hydriatrics* that the reader is referred to that article for further information.

By the word bath we designate a more or less prolonged immersion of the whole or part of the body in a liquid, vaporous, gaseous, or solid medium. Besides these four classes of baths there are mixed baths, semiliquid and semisolid, such as mud baths, manure baths,

baths of freshly pressed grapes, and special baths, such as electric baths, etc.

Before describing the different forms of baths employed and the manner of their administration it is necessary to consider the action of *heat* and *cold* on the organism. A temperature moderately warm, not above 104° F., increases cutaneous sensibility and produces a more or less intense redness of the skin in consequence of the dilatation of the capillary blood-vessels. This redness is the consequence of the heat exciting the vaso-dilator nerves and paralyzing the vaso-constrictors. A higher temperature, from 110° to 120° F., decreases or abolishes sensibility, and this fact is taken advantage of in the treatment of certain *neuroses;* if this temperature is administered slowly there is the usual dilatation of the capillaries, but if it is applied suddenly it causes spasmodic constriction of the cutaneous vessels and pallor and wrinkling of the skin.

A higher temperature is tolerated when the heat is dry than when it is moist. Bonnal stated that he remained fifteen minutes in a hot-air bath of 275° F., and for the same time in a hot-water bath of 114·8° F. In the latter experiment perspiration continued for an hour after the bath, and there was a total loss of weight amounting to 2,200 grammes, but this loss was recovered from in twenty-four hours. But such a toleration of hot air as that above mentioned is exceptional; ten minutes is long enough time for toleration of hot air at 269° F., a temperature higher than necessary to make steam. Under such exposure the body temperature rises only from 101·5° to 102° F. This is due to the fact that the air is a bad conductor, and gives less heat to the body than water, and also to the fact that the skin becomes covered with perspiration that evaporates and abstracts heat. The increased number of heart beats and the dilated state of the blood-vessels enable the skin to obtain an ample supply of blood for the formation and evaporation of sweat, but if the secretion of the latter is diminished the body is unable to endure the hot atmosphere. This is the explanation of a person's inability to tolerate so high a temperature in a vapour bath as in a hot-air bath; in the former, at from 127·2° to 140°, the rectal temperature may rise to 105° or even 107°, showing that the heat accumulates in the body.

If a person is placed in a bath in which the water has the temperature of the body, the normal temperature rises 1·80° in an hour, and in an hour and a half it may rise 3·6°. If the water's temperature is gradually increased from 101·5° to 104° the axillary temperature will rise to 102·2° within fifteen minutes.

A high temperature accelerates the contractions of the heart and increases the rapidity of the pulse, the latter reaching 160 a minute in a very hot air bath. Hence the contra-indication of very hot baths in those suffering from *heart disease.*

Moist heat at a high temperature increases, dry heat decreases, the number of respirations.

While a moderate degree of heat diminishes the irritablity of the nervous system, a high temperature produces nervous excitation, such as vertigo, cephalalgia, etc. Musso and Bergesio found in a person who had lost a portion of the scalp and skull that in a bath of from 100·4° to 102·2° three or four minutes sufficed to produce venous congestion and slowing of the pulsation of the cerebral blood-vessels, followed by cerebral anæmia and slight acceleration of the pulse, these latter conditions persisting for some hours after the bath.

A moderately warm temperature favours muscular work and slightly increases muscular excitability, but a high temperature diminishes excitability and renders the muscles incapable of sustained effort, in consequence of fatigue. This latter fact is taken advantage of in the treatment of *vaginismus* and *spasm of the glottis.*

The excitation by heat of the nerves supplying the sudoriparous glands increases the secretion of sweat, and this activity is furthered by the afflux of blood to the skin. As a result of increased perspiration, there is a decrease in the urinary secretion.

Remaining in an environment that has a higher temperature than that of the human body tends to produce a loss of weight, such loss being in direct ratio to the temperature of the environment and the length of the sojourn; and the loss is greater in hot moist air than in hot dry air.

Hot baths diminish interstitial combustion, lessen the absorption of oxygen, and diminish the exhalation of carbonic acid; the excretion of nitrogenous products, including uric acid, is increased. Such baths may produce or increase *glycæmia* and *glycosuria*, and their use by diabetics should be at moderate temperatures and not too prolonged. Henocque has shown that hot baths augment the reduction of oxyhæmoglobin, and Winternitz's investigations demonstrated that there was a diminution in the number of leucocytes.

Decided cold quickly produces a painful impression on the skin that may pass into complete insensibility. This fact is made use of in the production of *local anæsthesia*, and it is due to a spasmodic constriction of the capillaries with consequent anæmia and pallor of the integument.

Ordinary cold causes contraction of the cutaneous vessels, and the skin becomes pale, less soft, poorer in juices, and collapsed; its epithelium becomes dry. The radiation of heat from the surface, as well as the thermal conduction through the skin, is diminished by the contraction of the cutaneous vessels and muscles, and by the expulsion of the blood from the cutaneous and subcutaneous vessels. These facts indicate the necessity of rapidly drying the body on leaving the bath, for the exposure while the skin is wet causes chilling by evaporation during summer and by the action of the cold air during winter.

The constriction of the capillaries of the skin by cold is a reflex act; when the application of the cold is of short duration this action is only temporary and is followed by a reflex dilatation of the vessels, so that the constric-

tion and anæmia are followed by expansion and congestion of the tissues. In the majority of cases, notwithstanding the more or less marked redness of the skin, and despite the agreeable sensation of warmth felt by the individual after the application of cold, the temperature of the skin remains below normal for some time. This is due to the fact that the cutaneous redness is the result of paralytic distention of the capillaries; but the blood is cooled by coming in contact with the cool tissues, and it is not until the heart's action has forced a considerable amount of blood through the tissues that the normal heat is restored.

Everybody has realized that a slow and progressive immersion in cold water is much more unpleasant than a quick plunge into it. The shock is less intense if the body has been prepared for the reaction by exercise or friction. To many persons, such as neuropathic women and children, the impression of cold water is agreeable; to the phlegmatic or those having anæsthesia it is indifferent; while to some it is insupportable.

In its transitory action on the circulation cold excites the vaso-constrictors and paralyzes the vaso-dilators; but following the excitation of the vaso-constrictors there is depression, and gradually the paralysis of the vaso-dilators ceases, though certain medicinal agents may produce an intense cold that paralyzes the vaso-dilators for some time. This action of cold is the reverse of that of heat. Cold in its action on the general circulation retards the heart and diminishes the frequency of the pulse, although at the beginning of its application it produces an ephemeral acceleration that is succeeded by a retardation more or less marked in conformity with the low temperature of the water; these phenomena are due to the reflex influence of the peripheral excitation caused by cold water on the cardiac nerves. Rosenthal found that when animals were kept for a long time in a warm chamber their vessels lost to a great extent their contractile power, and in consequence the animals became much more readily chilled when exposed to cold. The periodical contraction of the cutaneous vessels produced by cold baths regularly taken tends to protect the individual from the injurious effects of accidental exposure.

A cold bath increases the activity of respiratory combustion in proportion, up to a certain point, to the degree of coldness of the water; the respirations become ampler and more profound. Quinquand's experiments showed that cold baths doubled or tripled the absorption of oxygen, and proportionately enhanced the exhalation of carbonic acid. In a very cold bath there is a diminution of the absorption of oxygen and of the exhalation of carbonic acid. The experiments of Richet, Henriot, and d'Arsonval show that cold baths increase the processes of oxidation and of interstitial combustion, and in consequence there is an increased excretion of waste substances. These changes are usually associated with an increased appetite, so that cold baths are a powerful tonic.

Cold diminishes, and at an intense degree may annihilate, muscular contraction. Its immediate effect on unstriped muscle fibre is to produce a more or less rapid contraction; the nipples are drawn up, the penis is contracted and curved, the prepuce is wrinkled, the testicles are retracted to the rings. There are chattering, shivering, and *cutis anserina.*

Moderate cold stimulates the brain and favours intellectual work, but a very low temperature is inimical to cerebral effort. In nervous persons a decided dry cold is more exciting than a humid cold. Reference has been made to the reflex action of cold on the capillaries—an action that may influence the secretion and dynamic functions of organs. For example, cold foot baths favour contraction of the uterine blood-vessels, or they increase the secretion of urine, or they diminish cerebral hyperæmia.

Contrary to heat, cold diminishes perspiration and consequently increases the secretion of urine. Wertheimer's investigations have shown that the action of cold on the terminations of the cutaneous nerves affects the renal, just as it does the cerebral, circulation. Ausset, Roque, and Weill found that in patients suffering from infectious diseases, such as typhoid fever, scarlatina, measles, etc., the toxicity of the urine was manifestly increased under the influence of cold baths.

Cold baths increase not only the number of red blood-corpuscles, but also the proportion of hæmoglobin. Henocque has shown that hot, like cold, baths increase the activity of the reduction of oxyhæmoglobin. Winternitz and W. S. Thayer found that not only in pathological, but also normal conditions, there was an appreciable leucocytosis after a cold bath that lasted as long as two hours; but while Winternitz believed that this was due to an increased exodus of leucocytes from the blood-forming organs, Thayer considered it a local condition incident to the cold and the friction.

James Curry was the first, about a hundred years ago, to scientifically demonstrate that the application of the cold bath decreased not only the peripheral, but the central temperature.

A well-known and able American physician, in his enthusiastic advocacy of hydrotherapy, writes that "precision in the temperature of water (which, if cold, may vary from 35° to 80°) is as important as is dosage of medicinal agents." While it has not been the writer's experience that a variation of a few degrees in the average temperature indicated for a bath will make any decided difference either in the comfort of the patient or in the therapeutic effects of the water, he does not believe that the temperature should be left to the chance of a difference ranging from 35° to 80°.

Each author on hydrotherapy seems to be a law unto himself in designating the temperature by certain terms. The following table will give an idea of these arbitrary divisions that are more theoretical than practical:

	Rostan.	Beni-Bardi.	Delmas.	Bottey.
Excessively cold	....	....	–42·8°	
Very cold	–54·5°	46·4°–53·6°	44·6°–50°	42·8°–53·6°
Cold	54·5° –63·5°	53·6°–60·8°	51·8°–59°	55·4°–62·6°
Cool	65·75°–77°	60·8°–68°	60·8°–68°	64·4°–77°
"With the chill off"	....	68·0°–78·8°	69·8°–77°	
Lukewarm or temperate	77·00°–88·25°	78·8°–86°	78·8°–86°	78·8°–89·6°
Hot	88·25°–99·5°	86·0°–104°	87·8°–95°	91·4°–96·8°
Very hot	99·5° –113°	104·0°+	96·8°–104°	98·6°+
Excessively hot	....	....	105 8°–122°	

Bottey has proposed that the classification of the temperature should rest upon a physiological basis furnished by the action of water at divers temperatures on the animal heat of an individual. Between the two facts that heat tends to increase the temperature of the body and that cold tends to lower it there is the middle term of a temperature that is devoid of influence on the organism. This middle ground evidently varies with the individual and his environment; but according to Liebig, Liebermeister, and others, water between 91·4° and 96·8°, inclusive, produces no elevation of animal heat. Each time an individual is exposed to water at a temperature of 98·6° or over there is an elevation of body temperature, and each time he is exposed to a temperature under 89·6° there is a depression of body temperature; therefore the former is designated as very hot water and the latter as temperate water.

The cold bath of the hydrotherapists is submersion in water having a temperature of from 45° to 55° F., the patient being kept in the water from a few seconds to a minute and being constantly rubbed while in it and vigorously dried with a rough towel as soon as it is over. The impression of cold that is consequent upon the immersion is very decided, the respiration is irregular, and there are horripilation and other sensory cutaneous disturbances that are relieved by the friction. These first symptoms of shock are of brief duration, as a rule, and are succeeded as the patient is removed from the bath by a feeling of warmth and stimulation that is a most agreeable reaction. This glow is the reaction from the decided concentration of the blood in the viscera and internal portions of the body, causing a thermogenetic action, and it has a powerful tonic and sedative effect. This bath is indicated in all conditions in which a strong cooling effect is desired, and it is especially useful in *insolation* and in *neurasthenia*, in which condition it is desirable to stimulate the circulation and the processes of metabolism. It should not be employed in *rheumatic conditions*, in *pulmonary* or *cardiac diseases*, in *neuralgias*, or in organic or functional conditions in which sudden hyperæmia would be undesirable.

The cold bath, as ordinarily given, is in water of a temperature varying from 65° to 70° F., the patient being taken to the tub or a movable tub being brought beside the bed, according to the disease and the patient's condition. Such a bath should always be given in a well-warmed room free from air currents, the patient's face should be washed with cold water, and he should have a compress of cold water placed about the head. A stimulant may be given to him, according to his condition, and he steps or is lifted into the water, lying down so that the water is around his neck, and it is important that it should cover the shoulders so as to avoid the risk of pulmonary congestion. The head may be supported by an attendant or rest upon an air cushion that hangs from the head of the tub. During the bath the head should be wet with affusions of cold water. While the patient is in the water the extremities and body should be vigorously rubbed. with the exception that in typhoid fever or dysentery the abdomen should be very gently massaged in order to avoid the risk of perforation. The patient, if an adult, may remain in the bath for from five to twenty minutes; from five to ten minutes will suffice for a child. The appearance of rigours or decided chilliness indicates the necessity of removal from the water. The patient is placed on a sheet resting on blankets, and these coverings are separately folded about him. hot bottles being placed at his feet. Brand advises that a patient should take a drink of cold water every fifteen minutes after the bath, but if there is much depression a little hot milk and Vichy or some hot bouillon is preferable. As soon as the patient has reacted from the immediate effects of the bath, usually within from five to ten minutes, he is dried with towels and placed under the bedclothes; if there is meteorism it is well to cover the right iliac region with a cold wet compress.

The bath should be repeated every three hours during the day and night if the patient's temperature exceeds 102° F.; if it is less than that there is no necessity of administering the baths so frequently. This holds true during defervescence and convalescence. The temperature should be taken every three hours, before, and also after the bath, to ascertain the degree of temperature reduction that has been obtained.

As Baruch truly says, the greatest gentleness and the least fuss should be associated with the bathing; the patient should be lowered at once into the water, in order to end the feelings of shock and oppression associated with this procedure. If there is respiratory difficulty, it may be relieved at once by a cold affusion on the head. A sense of well-being, as a rule, succeeds the preliminary shock, and it is five or ten minutes before the preliminary indications of the secondary chill are felt, provided the patient is constantly rubbed while in the tub. Associated with the chill are sensations of malaise; the chill is due to the decrease of the central temperature, which at first

may be slightly increased in consequence of the effect of the concentration of blood in the internal parts of the body. But the heat-loss of the circulating blood that results from the contact with the water, and the furtherance both of the circulation and of the heat abstraction by the cutaneous friction, soon increase thermolysis and lessen thermogenesis and the chill follows. Unless the face becomes cyanotic, there is little to fear from a ten- or fifteen-minute bath, notwithstanding the cyanosis of the body and the modification of the pulse.

The foregoing remarks apply particularly to the use of the baths for thermolytic purposes. Where the bath has been prescribed for its tonic effect, if it produces much discomfort, and particularly if there is not good reaction after it, the routine is likely to do harm rather than good. In such cases it is better to adopt some other form of cold applications, such as the sitz-bath, etc., after which vigorous friction will assist in bringing about reaction. [See HYDRIATRICS.]

The hot bath is a most useful adjuvant for the physician. The term is applied to the more or less prolonged immersion of the body in water having a temperature of from 80° to 95° F., or, if very hot, above 96° F. A bath at the first-named temperature has no marked influence on the human temperature, but acts principally on the skin, that becomes supple, with its contractile fibres relaxed and its pores opened. The peripheral nerves are agreeably and moderately stimulated, both peripheral and central nervous excitability being diminished; the sebaceous matter covering the skin is removed, particularly if the bath is associated with saponaceous friction; and the cardiac pulsations are diminished both in frequency and in force. But when the temperature of the bath is higher there is likely to be some elevation of both the central and the peripheral temperature; there is an increase in the number of cardiac contractions and consequently an acceleration in the frequency of the pulse; there is an increase in the number and amplitude of the respirations; the skin becomes red, the veins of the forehead are turgid, and there is perspiration.

Under the influence of the moderately hot bath the insensible perspiration is lessened and the quantity of urine is increased. Jardet found that the urine lost its acidity for some hours after the bath and might become alkaline, especially when the bath was very hot.

There may be some absorption in the hot bath, especially if the water contains gas. If the water is quite hot and the bath prolonged there may occur cephalalgia, ringing in the ears, syncope, and other symptoms of functional cerebral disturbance.

A very hot bath produces decided excitation of the cutaneous nerves and reflex vaso-motor action. On the patient's leaving the bath, even if it has been only moderately hot, there is more or less pronounced cooling of the surface of the skin, the reduction sometimes amounting to from 2° to 6° F. Dr. F. Bottey, who has reported the latter reduction of temperature, suggests that it explains the frequent recurrence of myalgic or neuralgic pains after a warm or a hot application. Consequently, after a hot bath the skin should be energetically rubbed and the patient wrapped in sufficiently warm covering, and great care should be exercised in immediately subjecting patients to the reaction of a cold douche.

The hot bath is indicated for its direct antispasmodic effects upon the nervous system, and is particularly advantageous in cases of excessive excitability, such as *maniacal excitement*, *hysterical mania*, *convulsions*, and *insomnia*, the bath being prolonged for from an hour to two hours or longer. Brierre de Boismont kept insane patients in the hot bath for from fifteen to eighteen hours, and in certain neuroses De Laurès continued the immersion for from thirty to fifty hours, in one instance even for two hundred and sixty hours. But such prolonged baths are likely to exercise a debilitating effect and are attended with many inconveniences.

In *lassitude*, in *muscular fatigue* consequent upon physical labour, in the *nervous excitability of pregnancy*, during the *preliminary pains of labour*, and in *vesical spasm* the hot bath exercises a rapid and salutary influence. It may be employed in the treatment of many external and internal *inflammations*, in general *bruising*, in *erysipelas*, in *strangulated hernia*, and in cutaneous diseases such as *variola*, *pemphigus*, *psoriasis*, etc. In certain local inflammations, such as *phlegmasia alba dolens*, *phlebitis*, *lymphangeitis*, *metritis*, *urethritis*, *orchitis*, *cystitis*, and *inflamed wounds*, the hot bath exercises not only a local but also a general sedative effect.

In *asphyxia neonatorum* one of the best means of stimulating the respiratory function and arousing the circulation is to plunge the child's body into water of a temperature of from 105° to 115° F.

A hot bath having a temperature of from 102° to 105° F., lasting for from fifteen to forty-five minutes, will often stop *metrorrhagia* or relieve *dysmenorrhœa*. Tarnier recommends its use in *uterine disorders in nursing women*.

Baths having a temperature of from 105° to 111° F. are very useful in the treatment of *chronic muscular* or *articular rheumatism*, and during their administration the patient should drink water freely. Such baths facilitate the appearance of the rash in the *exanthemata*, tend to keep up the animal heat and relieve the depression of *cholera asiatica*, of *dysentery*, and of *pernicious malarial fever*, relieve the renal congestion in *malarial hæmaturia*, and are of value in many chronic morbid conditions.

It is necessary to supervise the administration of very hot baths carefully, for they diminish the secretions, enhance the susceptibility to cold, and when prolonged may give rise to considerable debility. They should not be administered to persons suffering with long-standing *heart disease*, or to those having *apoplectic tendencies*, or to *diabetics*.

The alternating bath is administered by means of two bath tubs placed side by side, one being filled for a depth of about six inches

with water having a temperature higher than 98° F., while the second contains cold water. The patient is vigorously massaged and rubbed in the tub containing the warm water for about a minute, when he is quickly transferred to the tub containing the cold water, into which he is plunged for a moment and at once returned to the warm-water tub, in which the friction and massage are begun again. This procedure is repeated three or four times, the bath always terminating by the immersion in the cold water. This bath may be employed when a revulsive agent is desired and the douche is badly tolerated.

The *continuous bath* was highly commended by Hebra, who administered it in cases of extensive *burns*, *psoriasis*, *pemphigus*, and *variola*. He employed an ordinary bath-tub six feet long by three feet broad, in the interior of which an iron frame was fitted, and transverse bands of webbing were attached to the frame as in an ordinary bed. The frame was suspended in the bath by cords attached to it at each end; it was covered by a blanket and furnished with an air-pillow. The cords passed over rollers at the head and foot of the tub, so that the bed could be raised and lowered in the bath. At the head of the tub, but at a higher level, was a copper boiler, furnishing water of any desired temperature, that entered by a supply pipe at the bottom of the bath and escaped by a pipe at the water level, thus keeping up a continuous current. The water was kept at a temperature of from 90° to 100° F., and was entirely changed every day. A wooden cover, upon which a blanket was spread, was put over the lower part of the apparatus while the patient was in the bath. Hebra kept patients in such a bath for a hundred days uninterruptedly. Instead of the apparatus above described, rubber air-rings and pillows may be used to support the body, and by an easily regulated flow of warm water the patient may be kept in a continuous bath.

The hot-air bath is deservedly popular at the present time, because it allows of an exact graduation of the temperature of the air surrounding the patient, and may be administered in several ways.

The preferable method is by means of a wooden box, measuring from 2½ to 3 ft. wide, by from 3½ to 4 ft. deep, by from 4 to 4½ ft. high. The box is made air-tight, of well-seasoned wood; its front consists of a single or double door permitting of ingress and egress, and the top is perforated so as to allow of the passage of an adult's head. Within the box there are a stool, the height of which may be adjusted by means of a screw, and a foot-stool on which to rest the feet. The air within the box may be heated by means of a spirit lamp, or a small kerosene stove, or one or more Bunsen burners, or a steam coil. At a convenient point the box has a perforation to admit of the passage of a thermometer that will inform the physician of the range of temperature.

The patient enters the box, the stool is adjusted so that the head is free above the aperture, a sheet or bath towel being placed between the latter and the neck so as to prevent loss of heat, and a wet towel is placed about the patient's head. The heating is then begun, and the rate of pulsation of the temporal artery and the mouth temperature are taken at intervals of ten or fifteen minutes.

In a case in which the patient cannot be removed from bed, a frame consisting of two wooden or iron rods six feet long, connected at both extremities and in the middle by semicircular rods having a radius of from twenty to twenty-six inches, will support several heavy blankets and thus give a good space about the body. The blankets cover the frame and are tucked in about the patient's neck and around an elbow of stovepipe that is placed at the foot of the frame and hangs over the bed. Under the aperture of the stovepipe a kerosene-oil stove or a Bunsen's burner is placed, and the air within the blankets is speedily heated. A wet towel should be laid about the patient's head, the same as when he is in the box, and a rubber sheet should be placed beneath the bed sheet in order to prevent wetting the mattress by the perspiration. It is my custom to direct that a certain quantity of liquid, such as equal parts of Vichy and water or of Vichy and milk, be given the patient while in the bath, in order to promote diaphoresis.

A great advantage of this over the Turkish bath is that the patient's head is not in an atmosphere of hot air, he is enabled to breathe cold air, he runs no risk of cerebral congestion, and the physician or the attendant can easily converse with him and be informed of his wants. The head and face, nevertheless, participate in the general perspiration. When it is desired, a door or window may be opened while the patient is in this bath, so as to allow of the respiration of cold air, and there is not the least likelihood of bronchitis or pneumonia resulting therefrom.

With timid persons it is better to begin with a moderate temperature, gradually increasing the heat from the beginning to the end of the *séance;* otherwise if the elevation becomes too rapid the individuals become anxious and may have syncope. The maximum temperature that is comfortably tolerated is from 122° to 140° F., though Dr. Baruch states he has used a temperature as high as 180° F. These latter temperatures should not be continued more than from fifteen to twenty minutes, especially in persons affected with cardiac disease. When the desired temperature is attained, the bath is continued for some time until the perspiration has been sufficiently abundant, the temperature is gradually lowered, and then the patient is wrapped in blankets and placed in bed or rapidly given a cold sponging or, if he is strong enough to stand it, a Scotch douche or a cooling douche.

In a few minutes after the temperature in the bath has risen there are an increase in the pulse rate, a decrease in the arterial tension, and an increase in the temperature and the rate of the respiration.

Physiologically, the cutaneous vessels are dilated by heat; the skin becomes red, congested, and soft; it contains more fluids and becomes a better conductor of heat; the epithelium is

moistened by the sweat that appears on the surface, abstracting heat and favouring an increased heat excretion. The increased heart beats caused by the heightened temperature bring the blood more frequently in contact with the sudoriparous glands, which rapidly remove the watery elements of the blood as well as the volatile acids, albumin, and urea, and within an hour a patient in a hot-air bath may excrete more perspiration than he would ordinarily in twenty-four hours. This excretion is furthered by the administration of fluids while he is in the bath, so as virtually to wash the blood. The increased frequency of respiration, which Sihler's experiments have demonstrated is due to warming of the blood and particularly stimulation of the skin by the heat, causes an augmented consumption of oxygen and excretion of carbon dioxide, the latter due to the increase in tissue metabolism, so that in conditions of self-intoxication the elimination of the toxic products is materially hastened. Plethysmographic investigations have shown that, like all other substances, the human body is enlarged by heat. Landois states that a man weighing 60 kilogrammes is enlarged about 62 c. c. when his temperature is raised from 98·6° to 104° F. This enlargement is necessarily associated with expansion of the peripheral tissues and, as has been mentioned, with increased cutaneous congestion that occurs at the expense of internal depletion.

It is to be recalled that while the skin possesses emunctory it also has absorbent functions, and while certain toxic products are eliminated with the perspiration, if the bath is too long continued or if the body is not properly rubbed and cleansed after the bath, there may be resorption of these substances, just as there is absorption of mercury in a vapour-bath.

We may comprehend the useful part played by the skin in eliminating toxic products when we recall the peculiar odours associated with many diseases. It is one of the four emunctories of the body, and when either the kidneys, the intestines, or the lungs are crippled the skin may assist the disabled organs. Bouchard states that he does not believe in vicarious functions any more for the skin than for the intestine: that in increasing the cutaneous and intestinal secretions we remove a considerable quantity of water from the organism, but not what ought to be eliminated dissolved in the water, and therefore he thinks that the result of perspiration is not beneficial, since perspiration lessens the urine that should carry out of the system so many toxic products. That this idea is untenable is demonstrable, not only theoretically but practically. For example, Bouchard himself has shown that in intestinal fermentation resulting in self-intoxication the kidneys and the skin remove products that should be excreted by the intestine, and in uræmic conditions the skin excretes increased quantities of urea. Baruch has found that after the hot bath there is an increased elimination of urea, and this increase, though in a smaller degree, continues for some days; but it must be remembered that the urea increase is associated with a lessened quantity of urine. These results, however, are obtained in slight pathological conditions or in normal persons. In my own experience it does not hold good in severe pathological conditions. Measurements of the quantity of urine passed in the twenty-four hours in patients treated with hot-air baths do not show that the oscillation in the daily excretion of urine is associated with similar fluctuations in either the specific gravity of the urine or the quantity of urea that it contains. These observations have been made on hospital patients suffering with various diseases, most of whom were taking little if any exercise about a ward and none in the open air. And in no other way than by assuming that the skin acts vicariously for the kidney can we explain the cessation of uræmic coma as the result of treatment with the hot-air bath.

The effects of the hot-air bath are beneficial in chronic diseases of the thoracic or abdominal organs that are associated with *dryness of the skin*, *bronchial irritation* or other *congestive pulmonary conditions*, *hepatic* or *splenic congestions*, certain *chronic dropsies* of serous cavities, *chronic articular* or *muscular rheumatism*, including *lumbago*, *recent* or *chronic neuralgias*, *megrim*, *paludal cachexia*, *gouty conditions*, *scrofula*, *syphilis*, *diabetes*, *lead*, *opium*, or *mercury poisoning*, *poisoning by illuminating gas*, and *obesity*. The writer has found it especially useful in those self-intoxications due to so-called uræmic poisoning, such as *uræmic insanity*, *uræmic coma*, and *puerperal eclampsia*.

The contra-indications to the use of this bath are *organic cardiopathies*, although Anton Frey and S. Baruch have obtained valuable results by its cautious use in these conditions and in some states of *nervous excitation*. But, as it is a physiological fact that acceleration of the heart's action is the consequence of the direct effect of heated blood on its neuro-muscular substance, the great caution with which hot-air baths should be employed in cardiopathies becomes apparent.

The half-bath is given in a long tub filled to a depth of six inches with cold or temperate water that will just cover the legs and thighs. The shoulders, back, and chest are rapidly rubbed by an attendant, who wets his hands constantly with the water of the bath, and another assistant more or less vigorously massages the muscles of the loins and lower extremities, while the patient affuses his face and chest with water. These procedures should last for from three to four minutes, the frictions sometimes being diminished in frequency, but actively resumed if signs of chilliness are apparent. The half-bath at a stated temperature may be employed with success as an antithermic measure in certain cases of *typhoid fever* in which ataxia is associated with hyperpyrexia. It may be administered at intervals of from six to eight hours.

A variety of this bath in vogue with many hydrotherapeutists is to have the patient sit in a bath tub so that the water covers half of the body. The temperature of the bath is gener-

ally about 90° F. at the beginning, but the water is cooled gradually during the five to fifteen minutes' duration of the bath until the temperature is 75°. After a few days of this treatment the patient is placed in a bath that is reduced from 85° to 70°, then from 80° to 65°, and finally from 75° to 60°. During the time the patient is in the bath an attendant dashes the water on to the head, back, and chest, and gently rubs the back and neck, while another attendant rubs the limbs. This is an excellent measure in all cases of *nervous excitement*, *neurasthenia*, *alcoholism*, the *delirium of fever*, *insomnia*, "*spinal irritation*," etc.

The *sheet-bath* is applied by placing a rubber sheet on a bed and over this a blanket. A sheet is dipped in water of from 60° to 85° F., and, after being wrung partly dry, laid on the blanket. The patient's head and face are sponged with ice water, he is placed on the sheet, and the latter is wrapped about the body, the first fold being between it and the arms, the second fold over the arms and shoulders. The nurse at once begins to rub the body over the sheet from head to foot, and as soon as the heat of the body warms any part of the wrap that part is wet with water of the temperature used in giving the bath. The bath must terminate as soon as the patient shivers much, or when the body feels cool.

It is an excellent substitute for the full bath, and in from ten to thirty minutes it will reduce pyrexia. It may be administered in all *febrile conditions*, and it is an excellent tonic in *neurasthenia*, in *anæmia* due to various causes, and in *nutritional disorders*.

The sitz-bath is administered by means of a metallic receptacle consisting of a circular basin, large enough to hold the hips comfortably, that has a wide, flaring brim. The patient sits in the bath with enough water to cover his hips, his back supported by the brim of the apparatus and his legs extended horizontally, the heels resting upon a blanket, sitting in such a fashion that the muscles of the body are completely relaxed and the circulation is in no way impeded. In some hydrotherapeutic institutions the sitz-bath has a long extension to accommodate the legs and thus prevent any possibility of impediment of the pelvic circulation. The sitz-bath may be given with hot, cold, or running water, in the latter case the tub being supplied with a faucet and waste pipe and the water cold.

A cold sitz-bath lasting for a short time produces a decided circulatory reaction in the pelvic organs and in the skin of the submerged regions. In a few minutes the temperature of the rectum is lowered, and in ten minutes after the bath it is as much as 0·2° F. lower than before; but subsequently it rises, and for an hour may remain higher than it was before the bath. The pulse becomes slower, a diminution of twenty pulsations a minute having been observed after half an hour's immersion in water at 65° F., while the pressure is more or less increased. Respiration becomes deeper and slower and cutaneous perspiration is decreased.

This cold bath is indicated in all morbid conditions of the pelvic organs associated with disturbances of the pelvic vessels. It is useful in diseases of the genito-urinary tract in which there are enervation and enfeebled circulation; in *prostatorrhœa;* in *spermatorrhœa* due to atony of the seminal vesicles; in *atony* and *paresis of the bladder*, especially the *nocturnal incontinence of urine* of children; in *hæmorrhoids;* in *obstinate constipation;* in *chronic diarrhœa* or *dysentery;* in *rectal prolapse;* and in *amenorrhœa*, *dysmenorrhœa*, and *passive uterine congestions*. In *pregnancy* it lessens the sensations of dragging in the abdomen; but it should not be used if there is any tendency to abortion, on account of the effect of the bath in causing increased pelvic circulation. It may be used as a derivative agent in *cerebral* or *pulmonary hyperæmia*. In conditions associated with *chronic engorgement of the liver* and *spleen*, the influence of this bath on the hepatic and splenic circulation will be very useful. This bath should not be employed in *heart disease*, because of the exaggerated arterial pressure it produces at the moment of its application, and it should not be used where there is acute or subacute inflammation of the intestine, the uterus, the bladder, or the prostate. Neuralgia involving the pelvic nerves is a contra-indication to its use. The baths should not be administered oftener than once or twice a day, except in very rare cases in which it is desirable to produce quick excitation of the genital organs, when they may be repeated three or four times a day. Energetic friction after the bath accelerates and augments the revulsive effects consequent upon its administration.

The hot sitz-bath is employed to calm *nervous* and *circulatory erethism of the pelvic organs* and to lessen muscular contractility. At a temperature of from 90° to 95° it is essentially antispasmodic and antiphlogistic, and is indicated in the treatment of *acute* or *subacute inflammations of the pelvic organs*, in swollen or strangulated *hæmorrhoids*, in *spasmodic conditions of the bladder* and *urethra*, including *retention of urine*, in *hyperæsthesia* and *neuralgia of the bladder*, in *oophoritis*, and in *anal* and *vulvar pruritus*, etc. At a temperature of from 105° to 110° this bath may be used in *dysmenorrhœa* and *amenorrhœa*, in *lochial suppression*, and in *rectal prolapse*. These baths increase the bodily temperature and the volume of the pulse, but diminish the pressure. In certain cases the hot may be followed by a cold sitz-bath, or the temperature of the water may be reduced by adding cold water. Or the patient may sit in tepid water and have cold water dashed over the face, chest, back, and arms. A large Turkish towel is thrown around his body to prevent chilling while he is being rubbed dry. This is an excellent bath for the treatment of *laryngismus stridulus*. Diseases of the uterus and ovaries are often benefited by this treatment.

The *foot-bath* is a more or less prolonged immersion of the feet in a receptacle containing hot or cold water, the temperature varying from 40° to 110° F.

If cold water is used, the circulation in the feet should be stimulated by appropriate friction. The feet are kept in the water for from two to five minutes, and are energetically rubbed while in the bath. Afterward the friction should be continued and walking directed. The first effects of the cold foot-bath are painful, but under the influence of the rubbing the pain ceases. This is a powerful revulsive and derivative agent, and its action is more prolonged than that of the hot foot-bath; it attracts the blood to the lower extremities in *pulmonary* or *cephalic congestion.* By its energetic modification of the local circulation it is very useful for those that suffer with *cold feet*, as well as for those affected with *bromidrosis* or subject to *chilblains.* In *frostbite* of the toes or feet it should be resorted to at once. By its reflex operation it acts on the uterus and produces vascular contraction in that organ, and this suggests its use for a few minutes in certain cases of *menorrhagia.* In *scalds, contusions*, and *burns* of the feet their prolonged immersion in cool water is often advisable. It must be remembered that the foot-bath should not, as a rule, be given while gastric digestion is going on.

The hot foot-bath produces a rapid congestion of all the capillary vessels of the feet, and it has been proved experimentally that it produces the same phenomena, in a lesser degree, as the hot bath. It may be used for its revulsive effect to decrease *cerebral congestion*, and in general to draw the blood to the lower extremities; hence its use in menstrual difficulties. In cases of *amenorrhœa*, especially where it has been brought on by exposure to cold, hot foot-baths aid in restoring the menstrual flow. A foot-bath having a temperature of from 110° to 120° may be employed to relieve *plantar anæsthesia, tarsalgia, rheumatic arthritis*, and *sprains* of the ankle or foot. For the latter injuries the immersion should be continuous, and the water kept at a constant temperature. In ordinary conditions the hot foot-bath should be followed by immersion of the feet in cold water for a few seconds.

The hand-bath is the immersion of the hands in cold water for a longer or shorter time for therapeutic purposes. Hydrotherapeutists maintain that this procedure relieves *cerebral hyperæmia* in consequence of its having a reflex constrictive action. Vasalieff found in a number of experiments that if the hands were held in cold water for from fifteen to thirty minutes there was a lowering of the temperature in the external auditory meatus, a diminution of the pulse and respiration, a considerable decrease in the pressure of the temporal arteries, and a retraction of the retinal veins. Hot-water immersion, he stated, produced opposite phenomena. Cold hand-baths are of use in *epistaxis* and conditions dependent upon *cerebral hyperæmia.*

The reducing bath, or *graduated bath* of von Ziemssen, is administered in a bath tub containing water of a temperature of 9° F. less than that of the patient. For example, if the patient's temperature is 104°, the temperature of the water is to be 95°. The patient's body is immersed in the water and the extremities are rubbed; after the first shock has passed away cool water is added slowly, either by pouring it into the tub in such a way that it does not come in immediate contact with the patient or by allowing it to enter by a faucet placed near the bottom of the tub, until the temperature of the water in the tub is reduced to 80° or even 65°. During the entire bath the body and extremities should be rubbed by the attendant, and the patient should be removed from the tub as soon as there is well-marked chilliness. The immersion lasts for from twenty to thirty minutes, and when it is over the patient is at once wrapped in a warmed woollen blanket, in which he remains for from ten to fifteen minutes; he is then dried and put to bed. This bath does not produce in the patient the decided disturbances often provoked by the administration of the cold bath. It will reduce the temperature from 3° to 4·5° F., and, according to its originator, a reducing bath continued for thirty minutes will produce the same results as a cold bath of 60° F. continued for ten minutes. Von Ziemssen introduced its use in the treatment of *typhoid fever*, but it is equally applicable to all febrile conditions.

The vapour-bath is given in a close room in which there is watery vapour at a temperature of from 95° to 170° F. There are few that can tolerate the latter temperature, although it is said that the inhabitants of northern Russia and the Finns easily bear it. Generally a temperature of 104° is the highest that is consistent with comfort, though higher temperatures are readily tolerated in the hot-air bath. The time during which such a bath may last is from fifteen to thirty minutes, and after it the patient should be subjected to a reducing bath or a Scotch douche.

The vapour-bath is easily given in a hot-air bath, a vessel containing water being placed over the lamp or burner, or the vapour being introduced from without. The head being without the bath, and cool air being respired, it is possible for the patient to tolerate a temperature as high as 108°. The vapour condenses on the skin, and trickles down with the perspiration. This bath may last from ten to thirty minutes, and after its termination it should be followed by a cold affusion or douche in order to counteract the debilitating effects of the hot vapour, restore to the skin and muscles their normal tonicity, and calm the excitation of the circulatory and nervous systems.

Concerning the advantages of the vapour over the hot-air bath as regards elimination, Berger and Delaroche reported that in hot-air baths of temperatures from 122° to 125·6° F. the former lost 50 and the latter 150 grammes in thirteen minutes; while in vapour-baths of from 98·5° to 112° F. the first-named lost 310 and the second 220 grammes within twelve minutes. Wiegand states that the loss of weight will average 15 grammes a minute in a vapour-bath at 111°.

The physiological effects of the vapour-bath

closely resemble those of the hot-air bath, plus certain special features due to the action of the vapour on the skin causing maceration and softening of the superficial layers of epidermis, removal of the organic matter that obstructs the orifices of the sweat glands, and consequent stimulation of the cutaneous functions. Such results suggest the value of these baths to persons having *trophic cutaneous diseases* and those leading sedentary lives. In the latter, *nervous irritability* and *insomnia* are quickly relieved.

Care should be exercised in giving these baths that the temperature is gradually elevated, the pulse being carefully watched to see that the pulsations do not exceed 125 a minute, and the tendency to cerebral congestion being counteracted by the application of cold compresses to the head. The vapour-baths may be employed for the administration of medicated vapours, such as those of mercury, oil of turpentine, etc.

The leg-bath is the immersion of the legs in cold water for a varying length of time. Macario professed to have relieved *insomnia* by this procedure.

The elbow-bath, another limited form of the cold bath, was employed by Priessnitz to relieve *epistaxis*.

The Turkish bath of the present time is nothing but a form of the old Roman bath, in which friction and massage play an important rôle. Friction is practised by means of some rough, fibrous material that will remove from the skin all epidermic *débris* and stimulate the functions of the sudoriparous and sebaceous glands.

Medicated baths, exclusive of baths of mineral waters, which will not be considered here, but in the article on mineral springs, are those that are prepared extemporaneously by adding to the water a certain proportion of a medicinal substance, either acid, alkaline, saline, vegetable, or animal. While it is generally accepted that the skin absorbs in the bath some of the soluble substances that are brought in contact with it, it is also thought that the proportion of such substances that is absorbed is so feeble that it is unimportant in comparison with the topical effects of the bath.

Acid baths are prepared by adding a certain proportion of nitric, sulphuric, hydrochloric, acetic, or other acid to the water of an ordinary bath. For example:

Hydrochloric acid......	$\frac{1}{10}$ to 1 part;
Warm water...........	300 parts.

This is mixed with the water in a wooden tub, and the bath is administered two or three times a week for from fifteen to twenty minutes at a time. Such a bath was employed by Lendrick in treating *mercurial poisoning* and by Scott in certain hepatic diseases with *biliary retention*. Harley found that acid baths increased the irritation of jaundice. These baths are rarely used at the present time.

Alkaline baths are prepared by adding from 1 to 2 oz. of caustic soda or potash, or from 7 to 14 oz. of potassium or sodium carbonate to enough water for a full bath. An artificial Vichy bath may be prepared by adding 1 part of sodium bicarbonate to 600 parts of water; an artificial Plombières bath by mixing—

Sodium carbonate......	50 parts;
Sodium chloride.......	2 "
Sodium sulphate.......	6 "
Sodium bicarbonate....	2 "
Gelatin................	10 "
Water...........	30,000 "

The *alkaline bath* of the Fr. Cod., *balneum cum carbonate sodico*, is prepared by dissolving 250 grammes of crystallized sodium carbonate in 250 litres of water.

The Fr. Cod. gives a different formula for the Plombières bath, *balneum plumbieranum:*

Pure crystallized sodium carbonate...............	100 grm.
Purified sodium chloride...	20 "
Sodium sulphate..........	60 "
Sodium bicarbonate........	20 "
Pulverized gelatin.........	100 "

Mix the salts and keep them in a flask; the gelatin is kept separately and dissolved in 500 grammes of hot water when the bath is taken, the gelatin solution and the salts being mixed with from 250 to 300 litres of water.

These baths have been recommended in *chronic vesicular* and *squamous skin diseases*, in *prurigo*, *psoriasis*, *ichthyosis*, and conditions in which a palliative effect is desired. Their sedative effects have been found beneficial in *chorea* and in a number of *functional nervous disorders*. Harley has found them useful in *jaundice*, especially where there is much pruritus. *Chronic rheumatism*, *gout*, *urinary lithiasis*, and various visceral diseases may be benefited by their administration.

An aromatic bath is prepared by making a hot infusion of various aromatic herbs, such as thyme, rosemary, lavender, sage, absinthium, etc. It is used as a cutaneous excitant in *chlorosis* and some forms of *cachexia*. This bath is official in the Fr. Cod., and is prepared by dissolving 500 grammes of aromatic spices in 10 litres of water, then adding the solution to 250 litres of water.

An arsenical bath may be prepared by dissolving from 15 to 45 grains of sodium arsenate and 3 oz. of sodium carbonate in a bath tub of water. Guéneau de Mussy has found it very useful in *rheumatic arthritis* if administered daily or every other day, thirty baths sufficing to relieve the articular stiffness and pain. Sometimes at the beginning of the treatment there is gastric disorder, or the joint pain may be increased, but in a few days, on stopping the use of sodium bicarbonate, these symptoms cease.

A bromine bath is prepared by dissolving 20 drops of bromine and 2 oz. of potassium bromide in 30 gallons of water. It is used in *syphilis* and *squamous skin diseases*.

Emollient baths have been employed in the treatment of *cold abscess*, *lymphangeitis*, *phlebitis*, *acute arthritis*, etc. They are prepared by boiling for an hour 2 parts of marsh mallow, elder, bran, linseed meal, or almond meal in 10 parts of water, and adding this decoction to a tub of warm water. These baths may also be

employed in the treatment of *acute inflammatory skin diseases.*

Gelatin baths are prepared by boiling 1 part of gelatin in from 5 to 10 parts of water and adding the solution to a tub of warm water. They have been highly recommended for *skin diseases* in which nervous excitability is a prominent symptom. Gelatin added to a sulphuretted bath renders it more agreeable. The Fr. Cod. prescribes 500 grammes of powdered gelatin dissolved in 2 litres of hot water to be added to the bath when required.

An iodated bath is prepared by dissolving 10 parts of iodine and 20 of potassium iodide in 250 of water; this solution is added to water in a wooden bath tub. It has been used advantageously in the treatment of *scrofula* in children, in *syphilis*, and *squamous skin diseases.*

The mercurial bath is composed of 5 drachms of mercury bichloride, 2 oz. of alcohol, and 1 oz. of ammonium chloride added to enough water for a full bath in a wooden tub. According to the Fr. Cod., this bath, *balneum cum hydrargyrico*, is composed of mercury bichloride, 20 grammes; ammonium chlorhydrate, 20 grammes; distilled water, 200 grammes. This solution is added to a bath tub of water when it is desired. This bath is used in the treatment of various *syphilides*, except the ulcerative forms, in which there might be too much absorption. But at the present day the vapour-bath is almost exclusively used. This is given by placing the patient in a box such as that used for a hot-air bath, or by having him sit on a chair with blankets forming a tent over him from his neck downward. Calomel is sublimed within the tent by means of a spirit, gas, or oil lamp, and the heat generated by the flame suffices to produce perspiration and stimulate the skin so that the mercury vapour is absorbed.

A mustard-bath may be prepared by dissolving from 1 to 2 parts of mustard meal in 600 of warm water. Great care must be ob-observed in administering it that it does not produce too much irritation of the skin, and the patient should be kept in it but a short time. It has been given in the algid stage of *cholera* and in serious *congestion of the abdominal viscera.* The *mustard foot-bath, balneum sinapisatum* of the Fr. Cod., is made by dissolving 150 grammes of mustard meal in a sufficient quantity of water not above 104° F.

Pine-baths are made by adding a decoction of the shoots of the pine tree to water, or by using the oleum pini silvestris in the proportion of 1 minim to the gallon. These baths are used in *rheumatism*, *gout*, *paralysis*, *scrofula*, and *skin diseases.*

The *sea-bath* combines the advantages of hydrotherapy and climatic treatment. The cold salt water is a strong stimulant to the cutaneous nerves, and the motion of the waves is equivalent to a mild massage; together they diminish peripheral circulation and stimulate the respiration of the pure air of the seashore. Their use should not be too prolonged. They are beneficial in the so-called *scrofulous diathesis*, in *functional nervous disorders*, and in conditions of *malassimilation.* The congestion they induce is a contra-indication to their use in conditions in which there is a tendency to internal hæmorrhage.

Narcotic baths are prepared by boiling for an hour 1 part of poppy-seed, belladonna leaves, hyoscyamus leaves, datura leaves, or other narcotic in 10 parts of water and adding the decoction to a tubful of warm water. They have been used in the treatment of *acute inflammations of the genito-urinary organs*, *peritonitis*, *enteritis*, *external hæmorrhoids*, etc.

Saline baths may be prepared by dissolving from 8 to 10 parts of rock or sea salt in 300 of water. The Fr. Cod. prescribes for this bath, *balneum cum chlorureto sodico*, 5,000 grammes of sea salt in 300 litres of water. They may be employed as a tonic in debilitated subjects, especially for persons residing in the interior of the country.

Mud-baths, or *moor-baths*, while very popular in ancient times, have come into use again for remedial purposes only during the present century. They consist of a partial or complete immersion of the body in the mud or slime deposited from mineral waters, as in those of St. Amand, or of baths of peat or other earth, or of peat-earth impregnated with mineral waters, as at Franzensbad. The earth should be carefully sifted in order to rid it of coarse particles, and it is then mixed with water or mineral water so as to form a homogeneous mass. These baths are given at temperatures of from 98° to 124° F., as the patient is able to bear a greater degree of heat in them than in ordinary baths. They stimulate the skin partly by the heat and partly by pressure. There may be a decrease followed by an increase of elimination of nitrogenous substances and of sulphuric-acid compounds, and a decrease in phosphoric-acid compounds and the excretion of urine. These baths are useful in *rheumatic conditions*, *neuralgias*, *syphilis*, and *debility.* Anæmia is not a contra-indication, but in *cardiac diseases* the temperature must not be too high or the bath too prolonged.

A sand-bath is administered by burying more or less of the body in the sand for a quarter or half an hour, care being taken to protect the head from the sun. The patient soon perspires abundantly, and the sand forms an envelope that retains the heat, which soon becomes distressing and may produce debility or syncope. These baths have a tendency to exhaust the patient, for the amount of sweat excreted sometimes amounts to from 2 to 3 pounds; consequently he should be given a warm bath after them, be put to bed, and given stimulating food and drink. They are used in certain cases of *chronic rheumatism*, especially if there is muscular contracture, in *paralysis*, and for persons having a pronounced *lymphatic temperament.* They may be given in a tub filled with sand heated to 122° F.

Sedative baths are prepared by boiling 1 part of some herb having sedative properties, such as valerian, digitalis, hemlock, etc., in 10

parts of water and then mixing the decoction with a tubful of warm water. These baths have been used in treating *neurasthenia, hysteria,* and various *neuroses.* The tub should be covered with a sheet that is pinned about the patient's neck, so as to prevent inhalation of the fumes.

Slime-baths. See *Mud-baths.*

Stimulating baths are prepared by adding wine, alcohol, rum, aromatic alcohol, or aromatic vinegar to warm water. They have been employed to stimulate the activity of the skin, the muscles, and the circulation, and to relieve *debility* and *languor.*

Sulphurous baths are stimulating and useful in certain cutaneous eruptions, such as *herpes,* the *syphilides, scrofulous diseases, scabies,* etc., and in *articular rheumatism, catarrhs, lead palsy, chlorosis,* and *anæmia.* They may be prepared by mixing—

Sodium or calcium monosulphate.	50 parts;
Sodium carbonate or bicarbonate.	50 "
Sodium chloride................	50 "
Water....................	300,000 "

Or potassium sulphide may be dissolved in water in the proportion of from ½ to 1 drachm to a gallon. The Fr. Cod. directs for this bath, *balneum sulfuratum,* a solution of 100 grammes of potassium or sodium trisulphide in from 250 to 300 litres of water; and it prescribes a slight modification, *balneum sulfuratum liquidum,* in which the same quantity of ether salt is dissolved in 200 grammes of water, and the solution is added to the bath. An imitation of Barèges water may be made by mixing sodium sulphide, sodium carbonate, and sodium chloride in the proportion of 20 grammes of each to the gallon of water. In the Fr. Cod. the Barèges bath, *balneum baretginense,* is ordered according to the following formula:

Crystallized sodium monosulphite...............	60 grammes;
Purified sodium chloride...	60 "
Dry sodium carbonate.....	30 "

Mix and inclose in a flask and add the salts to the water on taking the bath.

The *tan-bath* is made by adding a decoction of from 2 to 3 quarts of tan bark to from 20 to 25 gallons of water.

The *Vichy-bath, balneum vichiense* (Fr. Cod.), is prepared by dissolving 500 grammes of sodium bicarbonate in from 250 to 300 litres of water.

Or if sulphur is added to a bath of hydrochloric or sulphuric acid, a part of it is converted into sulphuretted hydrogen.

Samuel T. Armstrong.

BEBEERINE, or **BEBERINE,** is an alkaloid found in the bark of *Neclandra Rodiæi,* said to be identical with buxine. The sulphate, *beberinæ sulphas* (Br. Ph.), a yellowish powder soluble in water, has been used as a substitute for quinine in malarial affections. The dose is from 1 to 10 grains.

BEEF PREPARATIONS.—See under Dietetic Treatment.

BELA FRUIT, the *belæ fructus* of the Br. Ph., is the dried half-ripe fruit of *Ægle Marmelos,* an aurantiaceous tree of Corea. It is used as an astringent in *diarrhœa* and *dysentery.* The dose of the fluid extract, *extractum belæ liquidum* (Br. Ph.), is from 1 to 2 fl. drachms.

BELLADONNA.—*Atropa belladonna,* a solanaceous plant, is indigenous to southern Europe and central Asia; grows to a height of from four to six feet, has dark-green ovate leaves, a purple blossom, and large purplish berries of the size of a small cherry, whence its German name of wolf-cherry (*Wolf-Kirsche*). The leaves and root are the parts used in medicine. The active principle of belladonna is the alkaloid, *atropine,* the sulphate of which is now very extensively employed in the treatment of such diseases as are favourably influenced by the grosser parts of the plant. The alkaloid is of special value in cases demanding immediate relief, and when the pharmaceutical preparations of belladonna itself would not be well received by the stomach, or when there is not time to wait for their absorption (see Atropine).

But, in ordinary cases, where it is as well or, it may be, better to get the slower and more even effect of the drug, it is advisable to use the tincture, the fluid extract, the extract, or, for external use, the ointment or plaster.

The physiological effects of belladonna have already been described in the article on atropine, and will be alluded to here only in connection with its therapeutic administration. For such administration it is used both externally and internally. *Externally,* so far as the eye is concerned, about the only use to which it is put is in the form of the extract or ointment, preferably the latter, to arrest *blepharospasm* by rubbing it upon them. In the absence of atropine it may also be used in this way to dilate the pupil; and, indeed, it has frequently been put to this use by women in order to secure a moderate pupillary enlargement and so to enhance the beauty and brilliancy of their eyes in the evening and by artificial light. Elsewhere, however, the ointment and plaster are frequently resorted to as means of allaying pain and swelling, or even of averting threatened suppuration. For instance, in the irritation or incipient *inflammation of the mammary glands,* when they become tumefied, tender, and heavy, the application of the unguentum belladonnæ or of a moderately strong solution of the sulphate of atropine has an important revulsive action, inducing anæsthesia, contraction of the blood-vessels, and diminution of the lacteal secretion and favouring resolution. In order, however, to prevent fermentation and the development of fatty acids, which irritate the skin and give rise to great distress at times, it may be well to incorporate some antiseptic substance with the ointment—say 5 grains of crystallized carbolic acid to the ounce. In fact, a simple solution of sulphate of atropine in distilled water may produce the same itching. This may be due to slight acidity of the

solution. It should be neutral in its chemical reaction. When belladonna is put upon the breasts, nursing should, of course, cease. Though children are less susceptible to its action than adults, still, the quantity that it is possible for them to ingest by this means, even when great care is taken, can not be considered perfectly safe. While considering the treatment of the breast with belladonna, it will be apropos to refer to the danger to a nursing child from belladonna or its alkaloid administered to the mother or nurse. The general testimony on this point is that there is no danger unless the dose taken by the woman is excessive. Ordinary medicinal doses may be given to a nursing woman without danger to the infant.

Aside from its use in hyperæmic and neuralgic conditions of the mammæ, belladonna is often resorted to in the form of ointment or plaster for *neuralgia* in other regions of the body, but particularly for intercostal and cervico-dorsal neuralgia, or even for pains in the lumbar region when they bear the marks of the neuralgic type. In the left infraclavicular, mammary, inframammary, and axillary regions, where intercostal neuralgias are frequent and where they are due to gastric irritation or distention, sometimes accompanied by disturbances of the cardiac rhythm, the plaster of belladonna is a really valuable application. Its efficacy may be very materially enhanced, in obstinate or very severe cases, or in cases accompanied by palpitation, by slightly moistening the surface of the plaster with tincture of aconite. But if the skin is thin and vascular, only a few drops of aconite should be employed, as, under the protection of the practically impervious plaster, there is an unusually good opportunity for its absorption. Some intercostal and abdominal neuralgias are more successfully treated by putting the plaster upon the back, in the interscapular region or lower, according to the situation of the pain; and the level at which it should be applied may be determined by bearing in mind that the dip of the intercostal and dorsal nerves is such that their terminations anteriorly at the median line are about three inches lower than their origins posteriorly from the spinal cord. Owing to the depth at which the cord lies, it would seem to be impossible that a plaster laid over the spinous processes could have any effect on the nerve origins in the spinal medulla. But it is well known that sedative as well as irritative centripetal impressions, when they are of sufficient power, are radiated to other portions of the same ganglionic centre and to associated ganglia. And the first branches of the spinal nerves, running backward between the transverse processes, distribute their terminal sensory filaments in the central region or zone of the back. Hence sedative impressions made upon these terminal filaments may relieve a neuralgia arising in the subjacent cord, although, subjectively, the pain is referred to an area at a considerable distance. The possibility of relief by this means is usually indicated by the existence of tender points over or in the vicinity of the spinous processes.

As an external application, belladonna is also of value in the case of some *lymphatic glandular swellings*, as well as in tumefaction of the parotid and other salivary glands. It may further be applied over *sprained* or *inflamed joints*. In any case, the previous application of a mild sinapism, just strong enough to redden the skin, will increase the efficacy of the belladonna or atropine. It will not do, however, to apply the linimentum belladonnæ to such a hyperæmic spot unless the precaution is taken of providing for free evaporation, also the camphor and alcohol which it contains may produce vesication, which, as a rule, is not desirable when we are following out a sedative plan of treatment.

[Belladonna was formerly held in repute as a remedy for *rigidity of the os uteri*, or rather spasmodic contraction of that orifice, during labour. It was applied to the cervix in the form of an ointment or injected into the vagina. The use of it for such a purpose has been superseded by the employment of warm douches and mechanical dilators.]

Internally, belladonna gives its most brilliant results in spasmodic diseases, and in such as are characterized by acute inflammations of the membranes of the brain and spinal cord.

In *whooping-cough* it is one of our most reliable remedies. After the first week it should be given in doses of from 3 to 5 minims every three or four hours, or until there is a perceptible though not excessive pupillary dilatation, or even a little reddening of the skin. The dryness of the throat and mouth, when annoying, may be relieved by small quantities of iodide of sodium or of potassium; by *minute* doses of antimonial wine; by ipecac, also in small doses, and in the form of the wine, as a rule; by the occasional administration of small amounts of calomel; or, to some extent, by chloride of ammonium.

Alum is also employed to modify the mucous secretion, which it renders less viscid and, at the same time, less copious, probably in virtue of the combined astringency of the aluminum and the liquefacient action of the sulphur and potassium which it contains. A very valuable formula for the administration of belladonna in whooping-cough is the following:

℞ Tincture of belladonna.	3 to 5 minims;
Alum..................	1 drachm;
Syrup of Tolu.........	1 fl. oz.;
Water.................	2 oz.
M.	

Of this mixture (in which the tincture of belladonna may be replaced by 1 minim of the fluid extract) the child may be given a teaspoonful every two or three hours, day and night, if it is awake. When the spasm is marked and very frequent the following formula may be followed:

℞ Tincture of belladonna..	3 minims;
Paregoric..............	2 to 4 fl. dr.;
Ammonium chloride...	1 drachms;
Ammonium bromide...	2 drachms;
Syrup of prunus virginiana, enough to make.	3 fl. oz.

Of this a teaspoonful, diluted, may be given every two or three hours. As these agents are all pretty rapidly eliminated from the body, the use of the medicine should not be interrupted during the night unless toward the end of the disease in recovery, when the patient is sleeping all night.

In other *spasmodic coughs* belladonna is also useful as an ingredient of the cough mixtures.

In *spasmodic croup* it may be very useful, though not as a means of securing immediate relief. As in *spasmodic asthma*, its operation is too slow, when it is administered internally, to give the quick relief so urgently desired by the patient. But in either case, after the violence of the paroxysm has been broken by other means—one of which may be the hypodermic injection of atropine or of atropine and morphine—its internal administration will serve to prolong and make secure the effect of the more powerful and rapidly acting drugs.

In *nocturnal incontinence of urine*, particularly in children, this is probably the most useful article in the materia medica. To be sure, if any local cause of irritation exists, this should first be removed, and its removal will sometimes be followed by the cessation of this annoying symptom.

The two most common causes are hyperacidity of the urine and, in female infants and children, ascarides. In male children balanoposthitis, with adhesion—usually spurious—of the prepuce, is probably, as a rule, the result of irritation of the glans and of the mucous surface of the prepuce by the acid urine. But when these causes do not exist, or when after their removal the nocturnal incontinence continues as a habit, from 2 to 3 drops of the fluid extract of belladonna, or from 5 to 10 drops of the tincture, at bedtime, beginning with the smaller dose and increasing it if necessary, will almost invariably effect a cure. Or a small tablet containing $\frac{1}{100}$ of a grain of sulphate of atropine may be used for the same purpose. When children or adults are subject to such spasmodic affections as laryngismus, asthma, or incontinence, it is wise to continue the administration of the remedy for some weeks after all the symptoms have disappeared, the doses, of course, being somewhat diminished in size, and occasionally, say every week or ten days, intermitted for forty-eight hours.

Spasmodic contraction of the rectum, when due to fissures, hæmorrhoids, continued constipation, or some idiosyncratic condition, is greatly relieved by belladonna, either given by the mouth or introduced directly into the rectum in the form of from $\frac{1}{4}$ to $\frac{1}{2}$ a grain of the extract made into a suppository with cacao butter. It is important in this case that the suppository be as small as can be conveniently manipulated by the patient. It should not weigh over 8 or 10 grains, and should be pushed beyond the internal sphincter, while the patient is in the recumbent posture. For this purpose the finger should first be smeared with the ointment of rose water, with simple ointment, or with some other bland lubricant; then the suppository, which is supposed to have been kept in a place cool enough for it to preserve its solidity, is quickly, and without being smeared, passed in on the end of the index finger and carried as far as possible into the rectum. When the limit of the internal sphincter is reached, the suppository will be felt to slip upward. The finger may then be safely withdrawn. If the suppository gives rise to pain simply by its presence as a foreign body, we may conclude either that it is too large or that it has not been passed beyond the internal sphincter.

The pain of *cancer of the rectum* is also greatly soothed and mollified in many instances by the action of belladonna in some form. It is also of great value in *pelvic affections in women*, particularly where there is hyperæmia, inflammation, or spasm. A suppository containing $\frac{1}{2}$ a grain of extract of belladonna may be introduced either into the vagina or into the rectum. If the vagina is made the receptacle, the suppository may contain a larger dose, even a grain of the extract, as there is considerable leakage, and it is usually advisable to secure it in its position by having the patient introduce it while in the recumbent posture at bedtime, and retain it in place by a small tampon of clean cotton batting (*not* absorbent cotton) or wool, with a light thread attachment to secure its easy removal. The vagina should be irrigated with hot water in the morning.

The serious cerebro-spinal conditions in the treatment of which belladonna and atropine have been found useful are *epidemic cerebro-spinal meningitis*, the *basilar meningitis* of children, usually, if not always, tubercular in its origin, and, to a limited degree, the various acute forms of *myelitis*, etc. The use of atropine in sunstroke has been referred to under Atropine. For the use of the drug in the last-mentioned diseases no definite directions can be given, as the practitioner must guide his action by the peculiarities of the cases. One cardinal principle, however, must always be borne in mind, which is that the drug must be given in doses sufficiently large to produce undoubted evidences of its full physiological effect, so far as this can be obtained when the tissues are not in their physiological condition. It may also be said that in cerebro-spinal meningitis, in which there is, so long as consciousness exists, great pain, the addition of opium or morphine to the belladonna or atropine increases its power for good very decidedly.

Tetanus also is said to have been cured by large doses of atropine, and there is no doubt that, in conjunction with other antispasmodics, analgetics, and stimulants, it is an extremely useful agent in the hands of a discrete practitioner. The important principle to be observed here is that it can not, alone, be relied upon to relax the spasm of tetanus (or of *strychnine poisoning*) except in doses which would be so large as to cause disastrous results on the circulation and respiration, as described in the account of its physiological action in the article on atropine. But as an adjuvant to other drugs whose action is in consonance with it its value is evident.

The treatment of *poisoning by belladonna* is

largely expectant. It is rarely fatal, and the main thing to do is to restrain the violence of the drug's action by moderate hypodermic injections of morphine, by the Calabar bean if this is at hand, by coffee, and by alcohol.

[Both the leaves, *belladonnæ folia*, and the root, *belladonnæ radix*, are official in the U. S. and Br. Ph's, also, the former as *belladone* and the latter as *belladone* (*racine*), in the Fr. Cod.; the Ger. Ph. recognises only the leaves, *folia belladonnæ*.

The *tinctura belladonnæ foliorum* of the U. S. Ph. is made by maceration and percolation of 150 grammes of belladonna leaves in enough diluted alcohol to make the product equal 1,000 c. c. The *tinctura belladonnæ* of the Br. Ph. is made with 1 oz. of belladonna leaves and 1 pint of proof spirit. The dose of the British preparation is from 5 to 20 minims.

The *succus belladonnæ* of the Br. Ph. is the expressed juice of the fresh leaves and young branches with the addition of one third of its bulk of rectified spirit. The dose is from 5 to 15 minims.

The *extractum belladonnæ foliorum alcoholicum* of the U. S. Ph. is made by reducing a strong tincture of the leaves to a pilular consistence by evaporation. This extract enters into the composition of the *emplastrum belladonnæ* and the *unguentum belladonnæ*. The *extractum belladonnæ alcoholicum* of the Br. Ph. is made from the root by a similar process. The dose is from $\frac{1}{16}$ to $\frac{1}{4}$ of a grain. The *extractum belladonnæ* of the Br. Ph. is made by evaporating the expressed juice of the fresh leaves and young branches. The dose is from $\frac{1}{4}$ to 1 grain. The *extractum beltadonnæ* of the Ger. Ph. is made from the fresh leaves at the time of flowering. The maximum single dose is $\frac{3}{4}$ of a grain.

The *extractum belladonnæ radicis fluidum* of the U. S. Ph. is made from the root in No. 60 powder, 1,000 grammes of the drug being used to produce 1,000 c. c. of fluid extract. This enters into the composition of *linimentum beltadonnæ*.

The *linimentum belladonnæ* of the U. S. Ph. is a solution of 50 grammes of camphor in enough *extractum belladonnæ radicis fluidum* to make 1,000 c. c. That of the Br. Ph. is made by maceration and percolation of 20 oz. of belladonna root and 1 oz. of camphor in enough rectified spirit to make the product 30 fl. oz.

The *emplastrum belladonnæ* of the U. S. Ph. consists of 1 part of the alcoholic extract of the leaves and 2 parts each of resin plaster and soap plaster; the British preparation is the same, except that the alcoholic extract of the root is used. The same difference exists between the *unguentum belladonnæ* of the U. S. Ph. and that of the Br. Ph.]

See also the article on ANALGETICS.

BENJAMIN F. WESTBROOK.

BENZANALGENE, a benzoyl derivative of quinoline, is credited with the analgetic and antipyretic properties of antipyrine, acetanilide, etc., also with being an antiseptic and a solvent of uric acid. It is almost insoluble in water. According to Dr. Cerna, it may be given to the extent of from $7\frac{1}{2}$ to 45 and even 75 grains in the course of twenty-four hours.

BENZANILIDE, $C_6H_5.CO.NH.C_6H_5$, resembles acetanilide in its action, and has been thought to have some advantage over that drug in the case of children—that of being freer from untoward after-effects. It is given to children in daily amounts of from $1\frac{1}{2}$ to 9 grains.

BENZENE, or *benzol*, has been used by Dr. W. Robertson, of Newcastle-on-Tyne (*Brit. Med. Jour.*, Dec. 30, 1893), in *influenza* with exceedingly good results. He prescribes it in doses of 5 minims, in mucilage, every two hours. Dr. Robertson says of this use of benzene: "Administered in mucilage, it has not been found to interfere with due nutrition. Producing, as it does, in nearly every case, such a rapid defervescence of the symptoms of influenza, as is to be expected, the usual sequelæ of the attacks are rarely or never noticed. Debility after this form of treatment is hardly appreciable by the patient. In one case before treatment pain in the ears, along with the other symptoms, was promptly relieved. In this case otherwise treated an acute catarrh of the middle ear might have been a probable event. In old and young alike the treatment proves efficacious, and it seems to act as efficaciously in debilitated as in robust subjects. Very few pulmonary complications have been noted in cases presenting themselves within the last few weeks, but it might be inferred that a remedy which so suddenly relieves the grave initial symptoms lessens the probability of pulmonary complications becoming established."

In *chronic bronchitis* and *winter cough* also Dr. William Murrell has found benzene very efficacious, used in the form of this mixture:

Pure benzene.	$1\frac{1}{2}$ drachm;
Peppermint oil.	$\frac{1}{2}$ "
Olive oil, enough to make. .	2 oz.

From 10 to 30 drops of this may be taken on a lump of sugar every three or four hours.

Benzene has been used topically in *diphtheria*, *scabies*, and *eczema*. For the destruction of the itch-mite pure benzene may be applied, but the eczema due to the presence of the parasite is said to be best treated with an ointment of benzene.

Benzene is a narcotic and irritant poison capable of producing death speedily when it is taken in large quantities. Its prompt removal with the stomach-tube should be accomplished, and then the stomach washed out with a bland fluid.

BENZEUGENOL, the benzoic ether of eugenol, has been used as an *internal antiseptic* in the same doses as guaiacol.

BENZOIC ACID AND THE BENZOATES.—Benzoic acid, $HC_7H_5O_2$, the *acidum benzoicum* of the pharmacopœias, is usually obtained from benzoin by sublimation, or prepared artificially, chiefly from toluol. It occurs in white or yellowish-white, lustrous scales, or friable needles, odourless or having a slight characteristic odour resembling that of

benzoin, and of a warm, acid taste; somewhat volatile at a moderately warm temperature, and rendered darker by exposure to light. It is soluble, when pure in about 500 parts of water and in 2 parts of alcohol at 59° F., in 15 parts of boiling water, and in 1 part of boiling alcohol. The dose is from 5 to 30 grains.

Ammonium benzoate, ammonii benzoas (U. S. Ph., Br. Ph.), $NH_4C_7H_5O_2$, occurs in thin, white, four-sided laminar crystals, odourless or having a slight odour of benzoic acid, and a saline, bitter, afterward slightly acrid taste. It gradually gives off ammonia on exposure to the air. It is soluble at 59° F. in 5 parts of water and in 28 parts of alcohol; in 1·2 part of boiling water and in 7·6 parts of boiling alcohol (U. S. Ph.). The dose is from 5 to 30 grains.

Lithium benzoate, lithii benzoas (U. S. Ph.), $LiC_7H_5O_2$, is a light, white powder, or small, shining, crystalline scales, odourless or having a faint benzoin-like odour, and of a cooling, sweetish taste; permanent in the air. It dissolves at 59° F. in 4 parts of water and in 12 parts of alcohol; in 2·5 parts of boiling water and in 10 parts of boiling alcohol (U. S. Ph.). The dose is from 5 to 30 grains.

Sodium benzoate, sodii benzoas (U. S. Ph.), $NaC_7H_5O_2$, is a white, amorphous powder, odourless or having a faint odour of benzoin and a sweetish, astringent taste. It is permanent in the air. It dissolves at 59° F. in 1·8 part of water and in 45 parts of alcohol; in 1·3 part of boiling water and in 20 parts of boiling alcohol (U. S. Ph.). The dose is from 5 to 30 grains.

The troches of benzoic acid, *trochisci acidi benzoici*, of the Br. Ph. contain half a grain of the acid in each lozenge.

Though benzoic acid is more irritating than its salts, its physiological action and that of the benzoates are otherwise practically the same. Applied to a mucous membrane or to an excoriated surface, benzoic acid is moderately irritating. Taken internally, the effect of benzoic acid in a full dose (30 grains) is to produce a moderate amount of epigastric warmth, slight increase in the bronchial and cutaneous secretions, and in some cases a moderate acceleration of the heart's action and of the respiration. Nausea and vomiting may occur, but, as a rule, they do not. The gastric irritation at times following the administration of benzoic acid is more marked than that seen after giving the benzoates. Benzoic acid and the benzoates are eliminated mainly by the kidneys, partly as benzoic acid, but chiefly as hippuric acid. The exact method by which hippuric acid is produced is not understood, though the change is believed to take place in the kidney itself. By thus leaving the body as hippuric acid, benzoic acid decidedly increases the acidity of the urine, a circumstance which gives to the drug its most important therapeutic application.

By internal administration as well as by external application benzoic acid is an *antiseptic* of no mean value, ranking as rather more powerful than salicylic acid. Its internal administration for antiseptic effect offers a great advantage over that of most of the other antiseptics (even salicylic acid), on account of its comparative harmlessness. That it is effective as an *intestinal antiseptic* is seen not only by an amelioration of symptoms under its use, but by a marked diminution of the amount of indican excreted.

As an *antipyretic*, too, benzoic acid has some moderate effectiveness, though it is by no means marked, being considerably less than that of salicylic acid. The continued use of benzoic acid is, however, decidedly safer than that of salicylic acid.

The most valuable therapeutic application of benzoic acid and the benzoates is in the treatment of *cystitis* with an alkaline or an ammoniacal condition of the urine. The acid itself is of great service in such cases, but the ammonium salt is to be preferred, since it is not only less irritating to the stomach, but more active in correcting the urinary condition. The value of the drug, so employed, lies not only in a correction of the urinary reaction and a consequent dissolving of the phosphatic precipitate, but also in a stimulating effect upon the vesical mucous membrane, thus promoting its healthier action, and furthermore in rendering the urine to a moderate degree antiseptic.

In conditions of urinary alkalinity short of phosphatic cystitis ammonium benzoate is very beneficial, the condition of *irritability of the bladder* or *incontinence of urine* associated with an alkaline urinary reaction being almost invariably relieved by its administration.

Phosphatic calculi are thought to be susceptible of solution by a benzoate, preferably that of ammonium, but the result is not attained save by a prolonged administration.

It was formerly held that the *uric-acid condition* was as much benefited as the phosphatic state by giving benzoic acid, and the acid and its salts were much employed in the treatment of *lithæmia* and even of *uric-acid calculi*, in the belief that uric acid was thereby diminished. Especially was the benzoate of lithium so used. The use of the drug for this purpose, however, seems not to be justified either by theory or by practice, and it has accordingly been abandoned.

From the antiseptic and stimulant properties it gives to the urine, benzoic acid has been recommended in the treatment of *gonorrhœa*, and in the later stages of this disease its action is often beneficial. In the acute stages it is not to be recommended.

Benzoic acid was at one time much used in the treatment of *articular rheumatism*. Senator went so far as to class it as the equal of salicylic acid in this disease. Further experience has, however, shown the fallacy of this view, for, while benzoic acid or its salts often seem to be of some benefit in the rheumatic, this benefit is usually but slight and in no way comparable to that derived from salicylic acid and the salicylates.

In *chronic bronchitis* benzoic acid and the benzoates were formerly much employed as stimulating expectorants, as were the tinctures of benzoin. At present, however, they are but

little employed, other remedies appearing more serviceable.

Benzoic acid and more commonly its sodium salt have been much lauded as antizymotics in the treatment of *acute septic* and *infectious diseases.* Many have reported most excellent results from their employment, but many others have been disappointed in them, and their value in such cases is, to say the least, unproved. If not always positively beneficial, they are practically harmless—a thing which can scarcely be said of the larger number of drugs so used—3, 4, and 5 drachms having been given in twenty-four hours without ill effect. In such cases the usual amount given is from 120 to 180 grains a day. The principal diseases of this class so treated are *septicæmia*, *puerperal fever*, *erysipelas*, *scarlatina*, *diphtheria*, and *whooping-cough*.

Though by the internal administration of benzoic acid *diphtheria* seems benefited but little or not at all, its application to the inflamed area by insufflation is frequently of value, as might be expected from a knowledge of its antiseptic properties.

In *tuberculosis* it was at one time given internally as well as (in pulmonary tuberculosis) by the inhalation, in spray, of a 5-per-cent. solution. From neither form of administration does benefit appear to have resulted.

Solutions of benzoic acid varying in strength according to necessity are often of value as mouth-washes where a mild antiseptic action is desired, and a troche containing $\frac{1}{2}$ a grain of benzoic acid is frequently effective in *subacute* and *chronic inflammations of the pharynx*.

The *benzoate of bismuth* is not official, but has recently been highly praised as a dressing for *sluggish* and *unhealthy ulcerations*, especially for *chancroid* and *specific sores*. In such cases it is often effective in cleansing the surface and promoting healthy reaction and healing. It is to be dusted freely upon the affected area. At times a moderate amount of irritation follows its application, but this is ordinarily but slight and of short duration.

HENRY A. GRIFFIN.

BENZOIN, the *benzoinum* of the U. S. and Br. Ph's, the *benzoe*, of the Ger. Ph., is a balsamic resin obtained from *Styrax benzoin*, a tree found in the West Indies as well as in South America and Central America. "It is almost wholly soluble in 5 parts of moderately warm alcohol, and in solutions of the fixed alkalies. When heated, it gives off fumes of benzoic acid. It has an agreeable, balsamic odour, and a slight aromatic taste." (U. S. Ph.)

The physiological action of benzoin is dependent upon the benzoic acid which it contains. Like the balsams, benzoin has a stimulating effect upon mucous surfaces. It is this property which formerly led to the use of the tincture and the compound tincture as stimulating expectorants in the treatment of bronchial affections, particularly *chronic bronchitis*. In such cases the utility of benzoin is, however, in no way comparable to that of others of the stimulating expectorants, and latterly benzoin has been but little used by internal administration.

Probably the most valuable employment of benzoin is for inhalation in *laryngeal affections*, and for this purpose it is in common use and highly thought of. Though of no small service in *chronic laryngitis*, its most marked benefits are to be seen in *acute laryngitis*, where, inhaled in steam, it is remarkably soothing to the inflamed mucous membrane. It must be granted, however, that the benefit derived from such treatment is probably as much due to the steam inhaled as to the benzoin. The ordinary method of its employment in a case of acute laryngitis is to put $\frac{1}{2}$ oz. of the compound tincture into a vessel of boiling water and then to allow the patient to inhale the steam as it rises laden with benzoin. To get the full benefit of the treatment it is wiser to confine the steam, either by means of a towel thrown over the patient's head or by making a cone of cardboard, the larger end to cover the vessel and the smaller to be applied to the patient's mouth.

A more elegant as well as a more accurate way of carrying out this treatment is by means of the porcelain inhaler for sale generally in our apothecaries' shops. The proportion employed in such cases is usually 1 drachm of the compound tincture to the pint of water. The inhalation is to be repeated, whatever the method employed, at frequent intervals.

The tinctures of benzoin have been used as sprays in laryngeal and pharyngeal affections, but to this use by atomization there is the practical objection that gumming and consequent stopping up of the tips of the spray tubes frequently results.

Beyond its use in acute laryngitis, the main value of benzoin is shown in its local action when used for external application. Thus used, it is both slightly stimulant and antiseptic, like most of the balsamics, and, moreover, protective. In *chapped* and *fissured hands* and *lips* it is serviceable when applied in the form of the compound tincture mixed with an equal quantity of glycerin. To *excoriated* and *fissured nipples* the same mixture may be applied, or the compound tincture may be painted on alone. In such cases the slight stimulant effect of benzoin is desirable, though the main service rendered is that of a protective. In *fissure of the anus* the compound tincture has been used in like manner, but it is rarely sufficient to effect a cure.

The tincture of benzoin and the compound tincture, when painted on excoriated surfaces, act, as has been said, slightly as stimulants and antiseptics, but especially as protectives, and this they do by virtue of a thin film of benzoin remaining on the surface after the evaporation of the alcohol. To *abrasions*, *small wounds*, *leech bites*, *bruises*, and *bedsores* the application of one of the tinctures will often be of great service. In *chilblains*, too, the compound tincture painted on the affected area will frequently be productive of good. As a protective application the value of benzoin is enhanced by its combination with collodion. This may be made by dissolving the

compound tincture, previously evaporated to dryness, in collodion.

On open *wounds* of some size, too, the application of benzoin is often of good effect; and when it is used on *granulating surfaces*, especially if granulation is sluggish, its effect is excellent. For this purpose the compound tincture is to be preferred, and it may be applied by means of gauze saturated with it.

Benzoin in the form of either of the tinctures was formerly much used as an application to foul-smelling and sloughing wounds, and appeared to act as a deodorizer and disinfectant as well as by promoting granulation and healing. In these cases, however, we now employ benzoin but little, since of late we have found other agents to be more effective and reliable, but in *old sinuses* with considerable discharge and little tendency to healing, a thorough injection of the tract with the compound tincture will, by virtue of its antiseptic and stimulant properties, often result in marked improvement.

The compound tincture is at times serviceable when painted upon the skin in skin diseases attended with itching. Thus in *eczema*, *urlicaria*, and *frostbile* it will sometimes prove effective as an anticnesmatic.

As a tonic and stimulant application to *spongy gums* the tincture of benzoin is often useful.

Benzoin in substance is hardly ever used medicinally. The tincture, *tinctura benzoini*, of the U. S. Ph. is made with 200 grammes of benzoin and enough alcohol to make 1,000 c. c. The dose is from ½ to 1 fl. drachm. The *tinclura benzoes* of the Ger. Ph. is a 1-to-5 solution. The compound tincture, *tinctura benzoini composita*, sometimes called friars' balsam, is made with 120 grammes of benzoin, 20 grammes of purified aloes, 80 grammes of storax, 40 grammes of balsam of Tolu, and enough alcohol to make 1,000 c. c. The dose is from 1 to 2 fl. drachms. The British preparation of the same name contains the same ingredients in the proportions of 2 oz. of benzoin, 1½ oz. of storax, ½ oz. of balsam of Tolu, and 160 grains of Socotrine aloes to 1 pint of rectified spirit. The dose is from ½ to 1 fl. drachm. Benzoinated lard, *adeps benzoinalus* (U. S. Ph.), *adeps benzoalus* (Br. Ph.), a mixture of 1 part of benzoin and 50 parts of lard, is used as a basis for various ointments, for which purpose it has the advantage over simple lard of not readily becoming rancid. The *adeps benzoatus* of the Ger. Ph. is a 1-to-99 mixture of benzoic acid and lard.

HENRY A. GRIFFIN.

BENZOL.—See BENZENE.

BENZONAPHTHOL, or *β-naphthol benzoate*, $C_{10}H_7.O(C_7H_5O)$, is a whitish, crystalline, tasteless, and odourless powder made by the action of benzoyl chloride on β-naphthol. It is almost insoluble in water, but soluble in alcohol, especially with the aid of heat. It has been used with much success as an *intestinal antiseptic*. It may be administered suspended in a gummy emulsion, but is preferably given in capsules. The dose is from 2 to 8 grains for adults, and the amount given daily should not exceed 30 grains for a child or 75 grains for an adult.

BENZOPARACRESOL, obtained by the action of sodium benzoate on paracresol in the presence of phosphorus oxychloride, has been proposed as a substitute for benzonaphthol.

BENZOPHENONEID.—This name was given by Galezowski and Petit to a tetramethyldiapsidobenzophenoid obtained by the decomposition of an aniline dye. It seems to have the same *germicide* properties as pyoctanin. A 1-to-10,000 watery solution, applied to the eye, has given very good results in obstinate *ulcers of the cornea*, in *purulent keratitis*, and in *phlyclænular ophthalmia*. (*Lancel*, Jan. 10, 1891, p. 115.)

BENZOSOL, a benzoyl substitution compound of guaiacol, is a colourless, odourless, and tasteless crystalline powder, insoluble in water and only slightly soluble in alcohol at ordinary temperatures. It is chiefly used as an *internal antiseptic*, especially in *intestinal diseases* and in *pulmonary tuberculosis*, in doses of from 3 to 8 grains and in daily amounts of from 15 to 45 grains, in tablets or capsules. Benzosol has been reported to have exerted a decidedly favourable action in *diabeles*, but the reports are conflicting. It is a potent poison, and should be used with great caution.

BENZOYLACONINE.—See ACONITINE.

BENZOYLGUAIACOL.—See BENZOSOL.

BERBERINE, an alkaloid, $C_{20}H_{17}NO_4$, found in several species of *Berberis*, has been used as a *stomachic* in daily amounts of from ½ to 3 grains.

BETA-NAPHTHOL.—See under NAPHTHOL.

BETOL, *naphthosalol*, or *naphthalol*, is a salicylate of β-naphthol. It is a tasteless and odourless crystalline powder, insoluble in water and only slightly soluble in alcohol. It is antipyretic and antiseptic, used especially in *fermentative* or *infectious diarrhœa*, *cystitis*, and *arlicular rheumatism*. The dose is from 2 to 5 grains, and from 15 to 30 grains may be given in twenty-four hours, preferably in capsules.

BIRCH TAR.—See under TAR.

BISMUTH.—Metallic bismuth is not employed in medicine. The preparations most frequently used are the subnitrate (*bismulhi subnitras* [U. S. Ph., Br. Ph.], *bismulum subnilricum* [Ger. Ph.]) and the subcarbonate (*bismuthi subcarbonas* [U. S. Ph.]). The *subnitrate* is a heavy, white, odourless, and almost tasteless powder, insoluble in water, permanent in the air, and having a slightly acid reaction. *Bismuth subcarbonale* is a pale yellowish-white powder, permanent in the air, tasteless and odourless, and insoluble in water. These two salts are practically identical in their medicinal properties, although it is thought by some that the subcarbonate is the blander and less astringent. It is slightly more soluble and is more readily decomposed into a soluble salt by acids and acid salts, and

its use in large doses is therefore not so safe as that of the subnitrate.

Bismuth citrate is used only in making the citrate of bismuth and ammonium (*bismuthi et ammonii citras* [U. S. Ph., Br. Ph.]). This salt occurs as small, shining scales, odourless, having a slightly acidulous and metallic taste, and being very soluble in water. It is the only soluble salt of bismuth employed in medicine. In its effects it differs widely from the insoluble preparations. It is more astringent and a decided irritant. It is inferior to several other vegetable and mineral astringents. The various proprietary preparations containing soluble bismuth combined with bitters and tonics are unscientific and wholly unreliable. It is, in fact, their insolubility itself which renders the subnitrate and subcarbonate so valuable for internal use.

Bismuth salicylate has been vaunted as a combination of two drugs valuable in the treatment of *gastro-intestinal diseases.* It has not, however, borne out the high allegations that have been made for it. Several recent observers regard it as an unsafe drug. The dose varies from 5 to 15 grains.

Bismuth, when introduced into the blood, acts as a poison, and the symptoms are similar to those produced by all the heavy metals. The official insoluble compounds, when strictly pure, may, however, be given by the stomach in enormous quantities without producing toxic symptoms. It is true that slight absorption takes place, but it is not sufficient to give rise to any constitutional symptoms. It is clearly proved that the poisonous effects which have been observed after the administration of bismuth have been due entirely to contamination with other metallic substances. Of these, arsenic is the most important, but free nitric acid has occasionally been found. With the improved pharmaceutical processes of recent years, it is rare to see toxic symptoms follow even the very free use of this drug. When obtained from reputable makers it does not contain impurities sufficient to cause any anxiety in its use.

During recent years bismuth has been very extensively used in the treatment of *gastro-intestinal diseases.* Its exact mode of action is still somewhat uncertain and its germicidal power is denied by many.

It possesses the advantage over almost every other drug of being able to reach every portion of the intestinal canal. In most cases of intestinal disease the lesions are in the vicinity of the cæcum. Soluble drugs are absorbed long before they reach this locality. Bismuth administered by the mouth reaches this region almost as certainly as it does the stomach. This no doubt explains in a large measure its peculiar action in many of the disorders for which it is commonly prescribed. Upon the stomach bismuth has a peculiarly soothing effect. In *acute indigestion*, after the stomach has been evacuated a full dose of bismuth has a marked effect in allaying irritability. *Vomiting* is sometimes relieved immediately by a large dose of the subnitrate. The patient should be kept quiet upon the back and all efforts to vomit should be resisted as far as possible. It is best to administer the dose immediately after an attack of vomiting, when the stomach is free from mucus and fluid. When the mucous membrane of the stomach is thickly coated with tenacious mucus, bismuth, like all other drugs, has little or no effect. When this condition is present, washing of the stomach by means of a tube will accomplish more than any drug. A somewhat less efficacious procedure consists in cleansing the stomach by means of copious draughts of water, either plain or containing a small amount of borax. When this is effected, a full dose of bismuth will sometimes prove most efficacious. *Gastric pain* due to functional dyspepsia is sometimes decidedly relieved by the administration of bismuth on an empty stomach. Gastric pain resulting from subacute gastritis or from irritation of the mucous membrane of the stomach is much mitigated by bismuth. At least 20 grains should be administered three times a day. Bismuth is indicated when gastric pain follows immediately after eating, with a tendency to diarrhœa and cramps. It is also of value when the bowels are inclined to act as soon as food is taken into the stomach. In this condition some other drug, especially arsenic or a bromide, may be required, but bismuth will prove of material aid. Bismuth is contra-indicated in gastric pain accompanying chlorosis or due to constipation. That form of indigestion marked by pain after eating, distention, acidity, and pyrosis is materially relieved, as a rule, by such a combination of bismuth and carbolic acid as the following:

℞ Bismuth subnitrate...... ½ oz.;
Carbolic acid............ 6 grains;
Mucilage of acacia....... 1 fl. oz.;
Peppermint water....... 2 fl. oz.

A dessertspoonful is to be taken after meals.

Chalk mixture may be substituted for the peppermint water if an alkali is desired.

Bismuth is one of the most useful remedies for relieving the pain of *gastric ulcer* or *carcinoma.* In these conditions, however, it is frequently necessary to combine it with morphine or hydrocyanic acid. Bismuth is one of the many remedies administered for the *vomiting of pregnancy.* In doses of 20 grains it is sometimes very efficient in checking this distressing disorder. It is rendered more so in some cases by the addition of carbolic acid, and in others it proves efficacious when combined with 10 grains of oxalate of cerium.

Bismuth has been used in all forms of *chronic* and *acute diarrhœa.* It should not be administered until the bowels have been freed from all decomposing matter by an evacuant. In chronic diarrhœa other drugs must frequently be added. It proves most efficacious in those forms of diarrhœa commonly known as *summer diarrhœa* which prevail among infants and young children during hot weather. It has stood the test of time, and in these diseases is more universally used than any other drug. The doses formerly advised were far too small. A child a year old may take 10 grains every

two hours. It may be administered in chalk mixture, or it may be suspended in simple mucilage and water, and given in combination with any of the vegetable or mineral acids or astringents. When opium is indicated it is unwise to add it to the bismuth mixture. The bismuth should be given at short intervals; the opium independently and at intervals of sufficient length to avoid the danger of sudden narcotism.

The condition recently described under the name of *cœliac disease* in children, characterized by large, loose, white, frothy, intensely fœtid movements, pallor of the skin, wasting, and loss of strength, demands bismuth in large doses and for a long period of time. The dietetic treatment is, however, of the utmost importance, and little will be accomplished if the diet is neglected.

It is asserted that if bismuth and pepsin are administered freely during the course of *typhoid fever*, the *diarrhœa* will not prove serious. This is not wholly true, but they will do much to prevent excessive diarrhœa. It should be remembered that in this disease the diarrhœa is a conservative process which it is not wise to wholly check. Bismuth is also a valuable remedy in the treatment of the *diarrhœa of phthisis*. It must be given in large doses, 30 or 40 grains every four hours sometimes being required. Like all other remedies in this condition, it loses its effect after a time, and other drugs must be substituted.

Bismuth is not tolerated by some patients, though this is rarely the case. It is sometimes persistently vomited by infants. In such cases it may be combined with aromatic powder, magnesia, or chalk. Chalk mixture with the addition of a little mucilage affords an excellent vehicle. Milk of magnesia may also be used for this purpose. When it is desirable to avoid the constipating effect of bismuth it may be combined with rhubarb or magnesia, the milk of magnesia being especially useful as a vehicle.

Externally, bismuth is largely used when a protective, sedative, and slightly astringent application is desired. It seems clear, on the whole, that it has slight antiseptic power. Its insolubility, by rendering long-continued application possible, greatly enhances its antiseptic effect. It enters into the composition of many dusting powders used for *erythema*, *intertrigo*, and *dermatitis*. For all these purposes, the subnitrate is almost exclusively employed. When not otherwise mentioned, this form of the drug is universally understood. As a dusting powder it is too dense and heavy for most cases. It is rendered lighter and more manageable by the addition of lycopodium. An excellent dusting powder consists of equal parts of bismuth, lycopodium, and powdered oleate of zinc. In diseases of the skin in which there is much discharge bismuth in powder is apt to cake and cause irritation. In such conditions an ointment is to be preferred. An elegant ointment for *erythema* and other mild conditions is composed of 1 drachm of bismuth in 1 oz. of cold cream. An ointment of bismuth and vaseline forms one of the best applications for *burns* and *scalds*. When the pain is intense, 2 grains of morphine or an equal amount of cocaine may be added to each ounce of the ointment. A small amount of powdered arrowroot may also be added with advantage, as it renders the ointment more tenacious. In *erythema*, *pruritus*, and numerous other conditions, a lotion is sometimes required. The following is an excellent sedative, anticnesmatic lotion:

℞ Bismuthi subnitrat........ ʒ ij;
Acidi hydrocyan. dil....... ʒ j;
Aquæ rosæ..............ad f ℥ iv.
M.

Bismuth has been largely used during recent years in the treatment of *urethritis*. Isolating injections are believed to be especially efficacious in keeping the opposite walls of the urethra from contact and in maintaining more persistent action of the remedial agent. The chief objection to their use is a tendency to clogging of the canal with a mortarlike paste. A small amount of glycerin partially obviates this difficulty, which is never a very serious one if an excessive amount of powder is not used. The following formula is a practical one. Hydrastis or a mineral astringent may be added if desired:

℞ Bismuthi subnitrat........ ʒ j;
Mucilag. acaciæ............ f ℥ ss;
Glycerini.................. f ʒ ij;
Aquæ...................ad f ℥ iv.
M.

In *dysentery* with *tenesmus* and *rectal irritation* and in *fissures* and *erosions of the rectum* injections of bismuth sometimes prove most efficacious. They are especially so in the dysenteric form of *colitis* seen in young children. For this condition, a drachm of bismuth is suspended in 3 fl. oz. of mucilage and water and injected high up into the rectum through a catheter. Bismuth often proves of material aid also in the treatment of *inflammation of the vagina*. A large gelatin capsule filled with the powder may be introduced high into the vagina after a cleansing douche.

Bismuth subnitrate is sometimes used as a snuff in *acute nasal catarrh*, in which condition it gives considerable relief. Ferrier's snuff is supposed to consist of 6 drachms of bismuth, 2 drachms of powdered acacia, and 2 grains of morphine hydrochloride. A celebrated proprietary catarrh cure consists chiefly of bismuth and cold cream. Alone and in combination with other powders, bismuth is frequently used for insufflation. The following is an excellent wash for *aphthæ* or the *catarrhal inflammations of the mouth* and *tongue*:

℞ Bismuthi subnitrat........ gr. v;
Glycerini.................. f ʒ j;
Aquæ rosæ.............ad ℥ j.
M.

Bismuth subiodide and *bismuth subbenzoate* have both been proposed as substitutes for iodoform. The only advantage alleged for them is freedom from odour. *Bismuth oleate*

is bland and soothing and enters into the composition of McCall Anderson's ointment:

℞ Pulv. bismuthi oxidi....... ʒ j;
Acidi oleici............... ℥ j;
Ceræ albæ................ ʒ iij;
Petrolati.................. ℥ j;
Ol. rosæ.................. q. s.
M.

This is one of the most soothing of all ointments. *Bismuth salicylate* is largely used as an antiseptic dressing for *ulcers, indolent sores,* and *epithelioma.* It has considerable antiseptic power. Bismuth is an ingredient of many cosmetics. In certain conditions, by forming some chemical reaction, probably with sulphur, it causes slight staining of the skin. It should never be prescribed externally in combination with sulphur, as staining is certain to follow.

[*Bismuth subgallate* will be treated of under its trade name of *dermatol. Bismuth naphtholate* (*beta-naphthol bismuth*) has been called by Dr. Hugo Engel (*N. Y. Med. Jour.*, March 30, 1895) the most trustworthy of all intestinal antiseptics, "especially indicated in all *fermentative bowel complaints.*" The dose for an adult is from 5 to 10 grains, three times a day.]

Floyd M. Crandall.

BISTORT, the rhizome of *Polygonum Bistorta*, is a mild astringent used mostly as a domestic remedy. It is official in the Fr. Cod. in the forms of powder and extract.

BITTERS are, strictly speaking, those substances which are possessed of a bitter taste. Any drug, therefore, which conforms to that requirement is entitled to the name, but practically the term is applied only to drugs whose sole or prominent action is dependent upon their bitter taste. Thus, aloes and morphine, though bitter to the taste and therefore, strictly speaking, bitters, are not used as such, since their other powers are more prominent and overshadow any action they might have as bitters. This possession of simply a bitter taste and a corresponding simple-bitter action is so common a characteristic of drugs, and especially vegetable drugs, that the pharmacopœia of bitters might be almost indefinitely inclusive, but no advantage would be the result of this multiplicity, for, with slight variations in strength, their actions are all the same, and those in common employment therefore compose a list of not immoderate length.

It is customary to make a subdivision of the bitters into the classes of simple bitters, aromatic bitters, and astringent bitters. The *simple bitters* are those whose only action is dependent upon their possessing a bitter taste, and the class includes quassia, gentian, calumba, nectandra, eupatorium, hydrastis, chirata, calendula, and cornus. Of these, calumba is the mildest and the least likely to cause gastric irritation. Though simply bitters, the larger number of this class contain tannic acid in appreciable quantity, which, while not sufficiently large to admit them to the class of astringent bitters, is yet enough to render them incompatible with iron salts, a tannate of iron resulting from their union. To this rule quassia and calumba are exceptions.

The *aromatic bitters* are those which not only possess the properties due to bitterness, but in addition contain aromatic oils, and hence, to some degree, produce the effects of aromatics. To this class belong canella, serpentaria, eucalyptus, anthemis, matricaria, absinthium, magnolia, cascarilla, and prunus virginiana.

The *astringent bitters*, in addition to bitterness, are possessed of such quantities of tannic or gallic acid as to have an appreciable astringency. The number of drugs this class includes is small, and, being on the borderline and transitional between the simple bitters and the vegetable astringents, many drugs which might be included in it are by the possession of greater bitterness or greater astringency cast into either of the two more prominent classes. Cinchona and salix, however, are classed as astringent bitters, and cornus, too, by some writers.

The action of the bitters is purely a local one, and, though they are sometimes referred to as the bitter tonics, their tonic effect is purely secondary to their local action and in no way comparable to that of systemic tonics, such as iron. The name tonic applied to them is, therefore, incorrect, since it presupposes a general and systemic effect which they in no way possess, for the increase in health, strength, and nutrition following their administration is due to their local action upon the digestive mucosa in causing increased appetite and digestion, by which more food is taken and assimilated. It is only indirectly, then, that they are tonic.

Taken internally, a bitter produces in the mouth a bitter taste, and this alone would serve to increase appetite, for there can be no doubt that if the bitter is so administered that it is not tasted its appetizing effect is lessened. In the mouth, too, it produces an increased flow from the salivary glands, and mixed with saliva it is swallowed. This increased saliva, when swallowed, produces the well-known effects of alkaline fluids, taken on an empty stomach, of promoting appetite and increasing the secretion of the gastric glands, and, though subordinate to the bitter, it is true, yet it serves to augment the action of that drug upon the stomach. Upon the gastric mucosa the bitter causes hyperæmia and acts to promote and increase the secretion of the peptic tubules, the result being increase of digestive power. To a lesser degree the same effects are produced upon the intestines, and from these there results increase both of digestion and of assimilation. Chemically, however, the bitters in no way promote digestion, but rather retard it. The therapeutic summary of the actions of bitters is therefore seen to be the production of a sensation akin to hunger and an increase of digestive activity, by which larger amounts of food are taken and assimilated. These in turn result in an improvement of bodily vigour and nutrition, and in this general improvement digestion participates, and thus the action of bitters becomes permanent.

A moderate increase in the production of gastric mucus as well as a moderate gastric hy-

peræmia follows the taking of a bitter, and, though the drug used will to a considerable degree determine the amount, calumba, as has already been said, being the mildest in action, yet this may easily become pathological, and large doses, especially if concentrated, may result in gastric distress, nausea, vomiting, and catharsis; while the too long-continued use of bitters is productive of gastric catarrh. These ill effects are especially likely to occur if the bitters are administered in health.

The indication for the use of the bitters is in general the condition of *digestive atony*, whether the effect sought is simply stomachic, as in *atonic dyspepsias*, or indirectly tonic and corroborant, as in *convalescence from acute disease*, *debility*, *malnutrition*, *cachexia*, and *marasmus*.

For these purposes the bitters, if used alone, are usually administered just before the time for eating. Combinations also of bitters with alkalies, mineral acids, pepsin, and bismuth are often employed, the time of administration being determined by the necessities of the case and the desired action of the other ingredients, for, though the bitters are more effective if given on an empty stomach, they are not inactive if given after eating. The combination, too, of iron in some form with a bitter infusion is often exceedingly desirable, the general tonic action of the metal being superadded to the digestive action of the bitter, and for this combination, as has already been said, both quassia and calumba are suitable.

Besides the conditions mentioned, there are others in which the bitters are occasionally employed, though to far less advantage. Thus, *obstinate vomiting* is occasionally treated by the administration of the bitters in small doses, and even in the *vomiting of seasickness* and the *vomiting of pregnancy* this action is at times beneficial. If, however, the vomiting is an evidence of gastric atony they are strongly indicated, and especially is this the case in the *morning vomiting of drunkards*. The bitters have also been thought serviceable in *malarial diseases*, but, while cinchona certainly is curative, this is not due to its action as a bitter, and the others of this class have apparently no specific effect, their power being limited to the occasional relief of the mildest of infections and to an adjuvant action when given combined with more effective remedies. While the bitters, therefore, are of themselves valueless in the active forms of malarial infection, they are of as much service in convalescence from malarial fevers as they are in all other conditions of convalescence, and valuable, too, in malarial cachexia for the same reasons and in the same way that they are valuable in debility from other causes.

The bitters will at times favourably affect a *diarrhœa* if it is due to intestinal relaxation, but are rarely to be employed if the diarrhœa is dependent upon inflammation. Infusions of the bitters are valuable as injections in the treatment of the *thread-worm* (*Oxyuris vermicularis*), and quassia in particular is so employed. Some expectorant power appears to reside in serpentaria and prunus virginiana, and they are frequently employed for this action as constituents of cough mixtures, while canella is thought to benefit pelvic disorders, especially *menorrhagia* and *metrorrhagia*.

Contra-indications to the employment of bitters are few, but, since these drugs are all to a greater or lesser degree irritants, they should never be employed in gastric or intestinal inflammations, if acute; in dyspepsia attended with much pain or vomiting, too, they are to be withheld or used with great caution; and in organic diseases of the stomach they are generally to be avoided.

Though contra-indicated in acute gastric inflammation, bitters are as strongly indicated in the atonic condition of the gastric mucosa associated with *chronic gastric catarrh*, and this in spite of the fact that their too long-continued use may in itself be productive of such a catarrh. In this action, therefore, they conform to the rules true of irritants—that long applied they cause inflammation, but their briefer application to chronically inflamed and relaxed areas is productive in them of stimulation to a healthier action.

The *choice of the bitter* to be used will depend upon the requirements of the case. The mildest of all is calumba. The aromatic bitters have, in addition to their power as bitters, some slight power as aromatics and carminatives. All bitters tend to increase peristalsis, and all save the astringent bitters to promote catharsis. With the knowledge of these characteristics, therefore, the selection of the drug suitable to the case will be easy, for bitterness and the consequent action as bitters are possessed by them all.

The bitters are usually administered in the form of tinctures or infusions, and, as there seems much practical advantage in the latter preparations, they are the most frequently used. Official infusions are exceedingly numerous in the Br. Ph., and, though few are recognised by the U. S. Ph., this does not prevent their frequent employment in this country. The bitter infusion is a favourite remedy in domestic practice, and a rather curious and unique example of this is seen in the use of the quassia cup. This cup is made from a block of quassia wood by turning, and in use it is customary to fill it with cold water and allow it to stand for several hours. There results from this a cold infusion of quassia which is then drank from the wooden cup.

Popular self-treatment is responsible for a vast number of proprietary preparations of which the main and active ingredient is a bitter, and, while popularity is no proof of excellence, and particularly in the case of "quack" medicines, yet in the enormous demand for such preparations we see evidence of the usefulness of the bitter drugs, for many of these preparations are indeed most excellent. As examples of drugs thus popular may be mentioned angustura and damiana.

Henry A. Griffin.

BLACKBERRY.—See Rubus.

BLACK DRAUGHT.—The mistura sennæ composita of the Br. Ph.

BLACK DROP.—Acetum opii.

BLATTA, or *periplaneta*, the cockroach, is found in the East (*B. orientalis*), in Russia (*B. lapponica*), and in America (*B. americana*).

From time immemorial cockroaches have been used by the Russian peasants as a remedy for all forms of *dropsy*. In 1876 Dr. Bogomolow, at the suggestion of Professor S. P. Botkin, undertook a series of clinical observations on the action of blatta when given in powder, decoction, infusion, and tincture. It was found that under the administration of any of these preparations the daily quantity of urine was increased. In dropsical patients the quantity of albumin in the urine was decreased, œdema of the face and limbs and ascites rapidly disappeared, the weight of the body was diminished, and perspiration was increased. The administration of cockroaches did not disturb digestion or irritate the kidneys.

Bogomolow found in blatta a crystalline acid principle that he called *antihydropin* or *taracanin*. This substance is probably identical with what Professor A. A. Loesch calls blattic acid (*acidum blatticum*), that is prepared by digesting powdered cockroaches with 70-per-cent. spirit. The fluid is filtered and evaporated to a dry residue in a water-bath, the residue is digested with diluted caustic ammonia, and this latter solution is shaken with fresh charcoal and treated with basic acetate of lead. The precipitate therefrom is washed with water, dissolved in 70-per-cent. spirit, treated with hydrosulphuric acid, so that the sulphide of lead may be separated by filtration, and then evaporated over a water-bath, producing light-brown crystals of blattic acid.

The acid is easily soluble in cold or hot water and in 95-per-cent. alcohol. It forms soluble crystalline salts with ammonium, potassium, and sodium. The blattates of barium, calcium, copper, lead, and silver are insoluble in water, but easily soluble in nitric acid.

Dr. Auguste Vinson, in a communication to the Paris Société de biologie, in 1816, reported that the vesicating properties of cockroaches found in the Réunion Islands were so marked that a labial herpetic eruption that he called *herpes blattæ* was frequently observed there. The eruption was produced by the *Blatta americana*, which was attracted to the lips of sleeping persons by the odour of food eaten by them during the day. He stated that for many years this vesicating property of blatta had been well known in the islands, and the insect had been employed empirically as an internal stimulant. In *infantile intestinal disorders* due to dentition, poor milk, or other insufficient nourishment, a decoction of from one to two roaches in 150 grammes of water or bouillon, or several powdered roaches in other food, sufficed to stimulate the digestive tube.

Dr. J. Tschernischew published in 1882 an inaugural dissertation in which he reported on the physiological action of blattic acid. In the frog this acid produced marked cardiac changes that were manifested by a retardation of the pulse after small doses and by a considerable acceleration after large doses. The retardation depended upon stimulation of the whole inhibitory apparatus of the heart, and the acceleration was due to paralysis of that apparatus. The acid lowered arterial tension in consequence of depression of the vasomotor centres of the spinal cord and the medulla oblongata. It excited the secretory structure of the kidney and produced marked diuresis. It caused death by paralyzing the cardiac muscle.

Various preparations of blatta have been administered by Bogomolow, Unterberger, Fronmüller, Köhler, Vyshinsky, Pohl, Budde, and C. Paul, in cases of dropsy due to Bright's disease, heart disease, and cirrhosis of the liver, and in 73 patients it more or less decidedly benefited the dropsical condition in 33 (45 per cent.), while it was of no use in 40 patients. L. Reuter has affirmed that the unfavourable results were due to the indifferent quality of the powdered insects sold in the market, the efficacy of the powder depending upon the percentage of blattic acid.

The insects, when dried and triturated, constitute a brown powder that has a peculiar odour and presents under the microscope fragments of the different parts of the cockroach and small undefined crystals. The taste is not disagreeable, and the preparation is readily taken by children. This powder is the *pulvis tracanæ*, an unofficial preparation used in Russia. The dose is from 2 to 8 grains, three or four times a day. The freshly powdered insect or a decoction, infusion, or tincture of fresh insects is more likely to give therapeutic results than a preparation that has been on hand for a long time.

SAMUEL T. ARMSTRONG.

BLEEDING.—See BLOODLETTING.

BLISTERS.—The effects obtained from the application of blisters are counter-irritation, slight depletion of the subjacent and adjoining tissues, a general depletion similar in effects to that of bloodletting if they are sufficiently large or the flow of serum is encouraged, a slight and temporary general stimulating effect upon the heart and nervous system, and a not clearly understood influence upon the nutrition of the deep tissues due to some effect upon the trophic nerves. Their use is contra-indicated in the extremes of life, in pregnancy, in purpura, in scurvy, in all acute fevers except those due to local inflammations, and in nearly all conditions in which the person is sufficiently ill to be indifferent to his surroundings, and they should not be applied to parts which are subjected to pressure or friction, to the hairy scalp, or to parts in which there is paralysis of sensation or motion. When for any reason hypodermic medication is impracticable or undesirable the same effects can be obtained by raising a small blister and dusting upon the raw surface whatever drug it is thought proper to employ. When, in the treatment of *neuralgia*,

morphine is indicated, this is a convenient manner of employing it. As a rule it is not desirable to blister over a surface larger than a silver dollar, and a number of small blisters, applied at intervals of twenty-four hours and close together, is usually more effectual than one large one covering the same area. One curious effect of blisters is an increase in the alkalinity of the fluids of the body, but it is not sufficiently great to be of any practical value. In the past, blistering has been greatly abused, and, as a result, a strong reaction against it set in, but at the present time it is regarded as being entirely proper and useful under appropriate conditions. The vesicant most commonly employed is *cantharis* in some form or other, and there are no special contra-indications to its use except the conditions in which its internal administration would be undesirable. It may be used in the shape of the cerate or ointment, cantharidated collodion, cantharides paper, or a blistering liquid or oil. Whichever form is used, it is important that the skin should first be thoroughly cleansed, and if the situation is such that the skin is thick and tough, or if a profound effect is desired, it facilitates the action of the vesicant if a mustard plaster or leaf is previously applied. Where, on the other hand, the skin is thin, or the patient is a woman or child, it is a good plan to interpose one layer or more of tissue paper between the blister and the surface of the body. The blistering fluid is very prompt in its effects, and may be applied by means of a brush or swab; spread on cloth or leather, the cerate is very effectual, the fatty matters aiding the action of the cantharides, but it is rather uncleanly; the collodion is the most easily applied, the most elegant, and the most commonly employed. It is simply painted over the surface, where it quickly dries.

No exact limit can be set as to the time it is proper to maintain any of these preparations in place, as the individual susceptibility to the action of cantharides differs so greatly, but as a rule a well-defined redness, which is the indication that they have been on long enough, is usually established at the end of six or seven hours. When, however, a very profound impression is desired, they may be left on for twenty-four hours. Shortly after their removal a number of small vesicles with clear contents form, which coalesce into one or more blebs. These may be pricked or allowed to remain untouched, according to the amount of irritation looked for, those in which the bleb is unbroken healing with greater rapidity. Formerly mezereon, savine, and other stimulating bodies were applied to the raw surface made by a blister, but at the present time they are rarely used save in veterinary practice. When rapid healing is desired, the surface must be dressed with boric-acid ointment or some other soothing ointment and covered with cotton, which acts as a protective and also as an absorbent of the serum. Those in which a bleb is not allowed to form are termed *flying blisters*, as are also those which are applied in succession over various parts of the body. A few drops of *chloroform* or *ammonia water* on a piece of cotton and held in place by a wine-glass, a cupping-glass, or a watch-glass will cause vesication, and their use is a very elegant method of blistering. *Corson's paint*, consisting of croton oil, ether, and compound tincture of iodine, has active vesicating properties, but is somewhat harsh in its action. *Chloral hydrate* held in position by a piece of adhesive plaster will excite a blister, but has no particular advantage except, perhaps, convenience. The long-continued application of *tincture of iodine* also will cause blisters, and *chronic joint affections* may be treated to advantage in this manner. The momentary application of heated bodies has been suggested as a substitute for the commoner agents, but it is painful, and the advantages obtainable from the more or less prolonged irritation of the peripheral nerves is lost. No matter what may be the agent employed, there are certain individuals who are very impressible by blisters, their application being followed by an increased frequency of the pulse, subsultus tendinum, and even convulsions—results which seem to be due to some effect upon the nerve centres. In these persons a moderate degree of reddening of the surface is all that is permissible, the bleb being afterward raised by a poultice.

When depletion is the object of a blister it must be applied over some part having intimate venous connection with the part to be affected, and when the relief of pain is the object, the point selected should be over the course of the sensory nerve distributed to the part. It is stated that the serum of blisters raised on the gouty at a point remote from an affected joint will contain uric-acid crystals, and that it is lacking in serum from those near it, so that in this way a diagnosis may be made in doubtful cases. All forms of *deep-seated inflammatory processes*—such as *meningitis*, *iritis*, *typhlitis*, *peritonitis*, *oophoritis*, and all varieties of intra-abdominal inflammation—are benefited by blisters after the most acute stages have passed, especially those of the pelvic organs in women, in which latter cases it is desirable to encourage the irritation by cantharidal cerate, ointment, etc. In *cerebral meningitis* the proper point for their application is over the mastoid process of the temporal bone, as is also the case in *otitis media*, and in *spinal meningitis* the nape of the neck, as when blisters are drawn lower down they are apt to be irritated when the patient is reclining. Their effect in meningitis of all types seems to be greatest in the direction of relieving pain, but they undoubtedly decrease to some extent the congestion of the inflamed membranes. In *iritis* the temple is the point to be selected, and the blisters should be small and frequently repeated; *inflammation of the mastoid cells* and the *headache due to intracranial lesions* are benefited by their application over the mastoid process. An attack of *epilepsy* may sometimes be aborted or warded off by a narrow blister encircling the limb from which an aura proceeds. In the various forms of *hysterical*, *sensory*, and *motor paralysis* it is probable that the good results often

obtained from blisters have a mental rather than a physical origin. Considerable discussion has been had as to their advisability and benefit in *pneumonia*, and it has been pretty generally agreed that in the early stages of this disease they are worse than useless, but that when resolution has set in they hasten it somewhat, due regard, of course, being paid to the general condition of the patient as regards strength, etc. The pain of *acute pleurisy* is undoubtedly lessened by blisters, and when effusion has occurred they may assist somewhat in its absorption, but to no marked extent. In *acute rheumatism* they are of undoubted advantage, lessening the pain and decreasing the liability to complications; indeed, mild cases may need no other treatment. In *chronic rheumatism* and other arthritic affections they may prove useful, but their employment must be kept up for months. *Persistent nausea*, the pain of *gastric ulcer*, and *colic* are sometimes relieved by a small flying blister upon the abdomen, but it is probable that the rubefacient action of mustard would prove just as effectual. In desperate cases of *collapse* and *coma* blisters may be used for their temporary stimulant effects, but only such cases are to be selected as those in which the system has to be tided over a dangerous point. Although not to be regarded as the only measure to be adopted, flying blisters are of very great service in the treatment of *neuralgia*, but to produce the greatest amount of benefit they must be applied, not over the seat of the pain, but as near as possible to the point at which the affected nerve has its exit from its osseous canal or intervertebral foramen. In *intercostal neuralgia* the best point is close to the spine and over the posterior branches of the nerve of the affected space; in *sciatica* it is often the case that they give more relief when applied over the nerve just as it issues from the pelvis, rather than over the roots of the spinal plexus from which it is derived; in *trigeminal neuralgia* the most desirable point seems to be at the nape of the neck, over the branches of the cervico-occipital nerve. Occasionally it is the case that a very slight irritation of the skin over the seat of pain is useful. *Hypochondriacal* and *hysterical pains* are not, as a rule, much benefited by blistering, being simply driven from one point to another. *Herpes zoster* is often put an end to by a blister over the posterior branches of the intercostal nerve of the space affected.

Russell H. Nevins.

BLOOD.—A few years ago considerable attention was paid (more, however, by the laity than by the medical profession) to the assumed great advantages in the use of uncooked bullock's blood fresh from the animal in the treatment of *pulmonary phthisis* and other diseases characterized by *wasting* and *debility*. At the first sight there would seem to be decided merits in this form of food, but a slight examination into the chemistry of blood shows that its value as a nutrient is not so largely in excess of that of other and less disagreeable articles. A fair estimate of the total solids places them at about twenty per cent., a figure which is closely approached by those of rich milk. The bulk of the nutrient elements of blood is made up of nitrogenous bodies, the fat rarely reaching two per cent. of the entire volume of blood. In milk the average of fat runs as high as six per cent. in good specimens, and it is therefore a much more desirable article of food in diseases accompanied by loss of weight. If the amount of nitrogenous elements does not appear to be sufficient in milk, the addition of any desired quantity of raw egg will form a mixture which closely resembles blood chemically and contains an equal amount of nutritious bodies.

Possibly the form in which the iron and other inorganic elements necessary for the proper nourishment of the tissues exist in blood renders them easier of absorption than when given in the ordinary medicinal preparations, but this advantage is very slight and does not counterbalance the decided objections to the use of blood.

Putting aside the difficulty of obtaining the blood clean and fresh, and the sentimental prejudice against it, there are well-defined objections to its use as obtained from the animal.

The first objection is the possible introduction of the *Tænia mediocanetlata;* the second, that of tuberculosis, which is extremely common among beef cattle and under the ordinary methods of inspection is not detected until the removal of the viscera; and the third, that of actinomycosis. This last danger is not very great, as the gross signs of the disease are so well marked.

Cooked blood is very largely used by many races and is, as a rule, free from the dangerous features of the uncooked. Fowls' blood is free from the objections above given, except that tuberculosis sometimes occurs in fowls, but so rarely that it is hardly worth considering, and, moreover, the examination of the viscera would take but an instant. This blood can easily be obtained free from admixture of foreign matters by suspending a fowl by the legs, attaching a weight to the bill, and, after cleansing the mouth, cutting the vessels which lie on each side of the vertebral column just behind the head. The incision should be made through the mouth, just back of the posterior nares, and the blood collected as it runs out of the mouth. The amount obtainable from each fowl will vary from one to three ounces, depending upon its size and the care with which the operation is performed.

About six ounces is the limit of the quantity to be given during twenty-four hours, and it can be diluted with sufficient milk to disguise its colour and taste.

The addition of a small amount of pepper and a little lemon-juice renders it more palatable to some persons, and may be tried if there is no objection to their use.

The conditions in which blood is pre-eminently useful are *pernicious* and *simple anæmia* and states in which it is desirable to diminish the bulk of the food as far as possible and carry the patient over a dangerous period. When it comes to the question of *rectal alimen-*

tation the advantages of this material would seem to more than counterbalance the objections to its use, especially as the above-mentioned complications are much less apt to occur. For this purpose the serum alone is used, the fibrinous portion being removed by whipping. This is without doubt more easily absorbed than any other preparation containing the albuminoids, on account of its alkalinity and the perfect state of solution of the nitrogenous elements it contains. If desired, it may be predigested with pepsin or pancreatin, but in the majority of cases it is just as efficient without them. The proper preparation of the rectum by washing it out with cold water must not be neglected, and a small enema containing from 10 to 15 grains of chloral hydrate is advised by some. The quantity of blood to be given in this manner should not exceed from 2 to 3 ounces, and the injection may be repeated according to the urgency of the case.

Subcutaneous and intraperitoneal injections of the serum have been practised with some success in the treatment of the anæmias, but as a rule their benefit does not seem to be very lasting.

As a remedy against *intestinal worms* of all kinds the serum has been used, generally by the employees of abattoirs, but it is not very effectual and presents no advantages over the measures more commonly used.

Russell H. Nevins.

BLOODLETTING is to be considered under two divisions: General bloodletting, or the removal of blood from the general circulation, usually by the opening of a vein of considerable size (venesection, phlebotomy), less commonly by the opening of an artery (arteriotomy); and local bloodletting, or the abstraction of blood from the capillaries and smaller vessels of congested or inflamed areas by leeches, scarification, and wet-cupping.

General bloodletting is a therapeutic procedure of the greatest antiquity, and, like many another agent of great usefulness, has by abuse been caused to fall into undeserved disrepute. Indeed, the position held by bleeding is not to be wondered at in view of the experiences following its use in the early part of this century, for then it was used as a more or less routine procedure in almost all cases of severe illness, as well as for prophylactic purposes. In fact, as Hare very aptly puts it, "people were bled with the same regularity that they were put to bed." The indiscriminate employment of a procedure so potent for harm when used in unsuitable cases or to an improper degree naturally was followed by disastrous results, and it fell into disrepute and disuse. So strong has been the prejudice thus caused that it is only within very recent years that bloodletting has again been employed, and even now its use is far from general, and, in fact, outside of hospitals, it is comparatively seldom resorted to. It is greatly to be regretted that such a condition should exist, for, while bleeding is undeniably a procedure of tremendous potency and one which in unskilled hands or improperly applied may be followed by the most disastrous consequences, yet its power for good is equally great, and in suitable cases it often accomplishes results otherwise unattainable.

In performing the operation of bloodletting a vein of moderate size is usually selected, and, while any of the superficial veins may be chosen, the most accessible and convenient are usually the median cephalic and the median basilic, less often the external jugular, the temporal, or the veins of the hand or foot. A vein is usually preferred to an artery for the employment of bloodletting, not only because it requires no subsequent ligating or after-treatment, but mainly because it is in cases of *venous engorgement* that bleeding is principally indicated. At times, however, bleeding from an artery is done, and then the temporal artery is the one usually selected, because of its accessibility, because of the facility of the application of effective pressure subsequently, and because of a fancied greater effectiveness in cerebral disorders when the blood is drawn from a neighbouring vessel.

The procedure in bloodletting is usually as follows: The arm having been bared, the skin in the flexure of the elbow is washed and made aseptic in the usual manner. A ligature, usually in the form of a handkerchief or bandage, is then applied tightly about the arm half way between the shoulder and the elbow. The venous stasis thus produced soon results in an engorgement of the vein to be opened—an engorgement which, save in very stout subjects, is usually sufficient to make the vessel's situation apparent. With all aseptic and antiseptic precautions the skin over the vein is then incised for a distance of from ½ to 1 inch along its course, and, the fascia and fat having been cleared from about the vessel, its anterior wall is nicked with a sharp-pointed knife. In opening a vein it is wiser to gently lift its anterior wall with a forceps and, catching that wall upon the knife's point, so to nick and open it; otherwise the posterior wall of the vessel may be injured. The blood will then generally flow freely, unless, as is exceedingly unlikely, the ligature has been so tightly applied as to have caused arterial as well as venous stasis. In some cases, however, owing to a thickened condition of the blood as well as to its sluggish movement, it becomes necessary to stroke the arm firmly from fingers to elbow, thus "milking" the bleeding vessel.

The amount to be removed will depend upon the constitution of the patient, the state of his circulation, and the necessities of the situation. In general, it may be said that bleedings vary in amount from 4 to 16 oz., and, since bleeding is not a procedure which is done save for conditions of seriousness and great importance, and therefore the removal of small amounts of blood is ineffective folly, the latter amount is more nearly the one to be removed, in the absence of contra-indications, than the former. There is no arbitrary rule, however, and during a bleeding the patient's condition is to be watched most carefully. Marked pallor of the face, weakness, and softness and dicrotism of the pulse are indications for the termination of the bleeding.

The proper amount having been withdrawn, the ligature is removed from the arm and the hæmorrhage stops. The wound is then dressed antiseptically and a firm bandage applied. So much leaking may occur from the cut vessel that it will become necessary to ligate it. Such a condition, however, is rare, and the simple dressing and the firm bandage are usually sufficient. The question of repeating the bleeding is an important one, and must be decided upon the merits of the case, but in general it may be said that the effects of a moderate bleeding last but a short time, that the loss of from 10 to 12 oz. of blood is a trivial one, that the weakening of the pulse from the bleeding is soon recovered from and the tone restored, partly by contraction of the vessel's wall, but mainly by the rapid absorption of fluid from the tissues, and that bleedings of from 10 to 12 oz. may usually be repeated at comparatively short intervals and, with careful and intelligent observation, without any great danger. Should the amount of blood removed have been too great, however, the usual symptoms of hæmorrhage are seen, and with marked pallor of the face, coldness of the extremities, a moist, clammy skin, rapid, feeble pulse, and general relaxation and weakness, there may be great "air-hunger," restlessness, anxiety, thirst, nausea, vomiting, syncope, epileptoid convulsions, and finally death.

The effect of the operation upon the blood is interesting, for, after bleeding, the fluid of the tissues is rapidly taken into the blood-vessels to restore the diminished volume of the blood, a fact which accounts for the increased thirst following hæmorrhage, as well as the increased absorption. Thus within a few hours the quantity of that fluid is the same as before, though in quality it is more dilute. An anæmic condition is thus established in which all the ingredients of the blood are diminished save the plasma. The restoration of the red blood-cells to their former number is only very gradually accomplished, and for a short time following the bleeding they may even grow fewer in number.

The results accomplished by bloodletting may in general be said to be diminution of the circulatory excitement, relief of congestion, inflammation, and pain, lessening of nervous irritability, production of muscular relaxation, promotion of absorption, and arrest of hæmorrhage. A further result is the removal of poison contained in the blood, though practically bleeding is employed for this purpose only in *poisoning by illuminating gas*.

The indications for the employment of bloodletting are, in general, conditions of *circulatory excitement* associated with a full and tense pulse, particularly when accompanied by evidences of *pulmonary engorgement* and an overworked and failing right ventricle, by the signs of *cerebral congestion*, and by *venous stasis*.

The contra-indications are those conditions of circulatory or general weakness in which it is evident that loss of blood will still further reduce the patient, as well as all diseases which are attended with wasting or marked by the typhoid tendency, or of which the course is apt to be prolonged. It is, moreover, unwise to bleed either the very aged or the very young or those known as "bleeders" (hæmophiliacs).

In the treatment of *convulsions* in adults bloodletting has its most valuable application, especially in *puerperal eclampsia* and in the convulsions occurring in *insolation*, for by it the cerebral congestion present in these conditions is lessened and the nervous irritability diminished. In all convulsive attacks is this power seen, though the procedure is not to be used ordinarily in the convulsions of epilepsy and hysteria, since it is unnecessary, and it is only with caution that it may be resorted to in those of uræmia, since in nephritis the general condition is often one of bodily weakness.

In *pneumonia*, the question whether to bleed or not is one which has caused endless discussion, and, while it can not be denied that, done early in the attack, bleeding relieves the sthenic symptoms of the disease and diminishes the pleuritic pain, it is apparently often the cause of an ultimate weakening of the circulation in a disease in which recovery depends on the preservation of the circulatory strength. In one condition in pneumonia its use is, however, strongly indicated—namely, that state of circulatory weakness in which by cyanosis, dyspnœa, and pulmonary and general venous congestion we recognise a distention and engorgement of the right side of the heart and of the venous system and a relative ischæmia in the arteries. Done for this condition, venesection will often suffice to re-establish the circulatory equilibrium, and for this purpose it has even been proposed to aspirate the right auricle. In this condition of venous engorgement, seen at times in other states, for example, sunstroke, bleeding is regularly indicated, but in the venous congestion and cyanosis associated with a failing circulation, especially in diseases of the heart and kidneys, and accompanied by a soft and feeble pulse, the employment of bleeding is not justified.

In that form of *pulmonary* or *bronchial hæmorrhage* seen in the plethoric, and generally to be regarded as conservative and a safety-valve to the intracranial vessels, a free bleeding is not only of use in stopping the pulmonary leaks, a thing which it accomplishes by lowering the general blood-pressure, but also often of value for the plethora itself. In the hæmorrhage of phthisis the exhausting tendency of the disease is a direct contra-indication. In the early days of *meningitis*, *pleurisy*, and *peritonitis* in the young and robust bleeding may be done, and both as an antiphlogistic and in the relief of the pain associated with these conditions its effectiveness is marked; but it is doubtful if such employment of it is wise, for to produce these results we have other means quite as effective, and means, too, with which the relief is not purchased at the price of a subsequent debility. On the inflammatory condition bleeding exerts no specific effect; its action is solely due to a temporary diminution of blood-pressure, a thing which in such cases can be quite as well accomplished by the circulatory depressors, aconite and veratrum viride, which have often

been said to act "by bleeding a patient into his own vessels."

In *cerebral apoplexy* a free bleeding is effective in relieving the circulatory excitement usually associated with that condition and in preventing the further escape of blood from the ruptured vessel. In the form of *acute cerebral congestion* often called apoplectoid, and clinically frequently indistinguishable from apoplexy, bleeding is regularly indicated, both for the relief of symptoms and for the prevention of intracranial hæmorrhage.

In *poisoning by illuminating gas* free venesection, followed, if necessary, by transfusion, is indicated in all but the mildest cases, for by its action the poison directly combined with the hæmoglobin is removed, a thing which in all cases of gravity is of immediate importance and not by other means to be accomplished. See LEECHING, CUPPING, and SCARIFICATION.

HENRY A. GRIFFIN.

BOLDO.—The leaves of a Chilean shrub, *Boldoa fragrans.* They contain a poisonous alkaloid, *boldine*, and a glucoside, *boldoglucin.* Boldoglucin is an amber-coloured, syrupy liquid of an aromatic odour and taste, soluble in water and in alcohol. It has been recommended as a hypnotic, also as a remedy for *biliary lithiasis*, in daily amounts of from 30 to 60 grains. The volatile oil of the leaves has been used in *gonorrhœa*, in doses of 5 drops in capsules.

BOLETUS.—See AGARIC.

BONDUC, the seeds of *Cæsalpinia* (or *Guilandina*) *Bonducella*, has been used as a substitute for quinine in the treatment of *malarial disease*, and is said to act in many cases quite as efficiently. It is given in substance in doses of from 7 to 10 grains twice a day. The dose of its active principle, a resin termed *bonducin*, is from 1½ to 3 grains.

BONE MARROW.—See MARROW.

BORACIC ACID.—See BORIC ACID.

BORAX (Br. Ph.), or *sodium borate* or *biborate*, *sodii boras* (U. S. Ph.), a salt freely soluble in water and in glycerin, but not so readily in alcohol, and having the formula $Na_2B_4O_7$, has been given internally in very large doses without any unpleasant results, but its too long continued use is followed by the establishment of a cachexia due to the sodium it contains. Locally, it is slightly stimulating to mucous or raw surfaces, and, on account of the boric acid which enters into its composition, is more or less disinfectant. The official preparations, the glycerite and honey, are largely used in the treatment of *ulcerative stomatitis* and the *aphthæ* of nursing infants, but a mixture of equal parts of the powdered salt and fine sugar applied to the diseased surfaces or allowed to dissolve on the tongue is rather to be preferred. All *aphthous sores*, wherever situated, are equally benefited by any of the preparations mentioned. Combined with honey and with tincture of myrrh, borax is used successfully in the treatment of *spongy gums.* Its slight astringent properties render it a useful application to *fissures of the nipple*, *abrasions of mucous surfaces*, *ulcers*, and *superficial burns.* A 5-per-cent. aqueous solution lessens, and in some cases entirely removes, the discolouration of *freckles* and *chloasma.* A solution of the same strength is usually sufficient to effect a cure in mild cases of *conjunctivitis*, especially when the eyelids stick together in the morning. For *chilblains*, an ointment containing 2 drachms of borax to the ounce is recommended, but it is not so useful as iodine ointment. The distressing *pruritus* in women, which sometimes spreads over the perinæum and pudenda, and often extends up into the vagina, can generally be cured by persistent douching of the parts affected with water as hot as can be borne containing about 2 per. cent. of borax. A piece of the size of a pea placed on the tongue and allowed to dissolve will temporarily relieve *hoarseness* and *aphonia* due to overuse of the voice by singers and speakers, and, used in the same manner or mixed with honey, it is an excellent remedy for *laryngitis* of a mild type. Alkaline *leucorrhœal discharges* are very satisfactorily treated with hot douches containing from 5 to 10 per cent. of borax. For the removal of scabs in various *cutaneous disorders*, a solution in which sufficient of the salt has been dissolved to give a slippery feeling to the fingers is much better than alkaline solutions, on account of its being less irritating and having slight disinfectant properties. The powder scattered in places infested with ants or roaches usually drives them away, and this use of it is entirely safe. For cleansing sponges, hairbrushes, etc., it is better than almost anything else.

In *uric-acid lithiasis* it has been used with gratifying results in doses of from 5 to 30 grains, freely diluted in water. The salt reaches the bladder nearly unchanged, where the sodium unites with the uric acid to form soluble urates. The boric acid set free in this decomposition probably plays an important part by its soothing and disinfecting action. At the same time irrigation of the bladder with a 5-per-cent. solution is a very useful adjuvant. While this treatment is extremely good, it has been found that the use of magnesium borocitrate and potassium tartroborate is rather better, as the urates formed are more soluble. *Uterine hæmorrhage* is sometimes lessened by large doses, but there seem to be no indications as to the cases in which it will prove successful. This salt may be substituted for boric acid in almost all cases in which the latter is used internally. For internal use, the dose ranges from 5 to 30 grains, although as much as ½ oz. has been taken without evil results.

[Borax has been used to a considerable extent as a remedy for *epilepsy.* Dr. Edward A. Welch, of Sutton, Massachusetts, who has made a careful study of the records of its use in this disease (*N. Y. Med. Jour.*, Nov. 25, 1893, p. 626), concludes that, while borax cannot be said to be as efficient as the bromides, it is of great service in certain cases, especially those characterized by nocturnal paroxysms. Dr.

Welch mentions Munson's opinion that the borax treatment of epilepsy is most useful when the action of the heart is strong and the arterial tension is low, on the theory that the drug exerts a remarkable constricting action on the peripheral blood-vessels, and so tends to prevent cerebral anæmia, which has been thought to play a part in giving rise to the paroxysms. In the treatment of epilepsy with borax it is usually sufficient to give 10 grains of the drug three times a day, but much larger doses—from 40 to 60 and even 120 grains in the course of twenty-four hours—have been given without producing any serious ill effects. The first few doses sometimes cause diarrhœa, but this yields to some aromatic or to bismuth salicylate. In some cases this use of borax has given rise to various cutaneous rashes. Dr. Welch speaks favourably of the use of compressed tablets each containing 5 grains of borax and ¼ a grain of ginger.]

Glycerine of borax, *glycerinum boracis* (Br. Ph.), is made by dissolving 1 oz. of borax in a mixture of 4 fl. oz. of glycerin and 2 oz. of distilled water. Honey of borax, *mel boracis* (Br. Ph.), is a mixture of 2 parts of finely powdered borax, 1 part of glycerin, and 16 parts of clarified honey. The French tablets of borax, *tabellæ cum borate sodico* (Fr. Cod.), contain about 1½ grain each of borax and are flavoured with tincture of benzoin.

Russell H. Nevins.

BORIC ACID, *acidum boricum,* forms white scaly crystals of a faint acid reaction, having the formula H_3BO_3, soluble in about 26 parts of cold water and readily soluble in hot water, in alcohol, and in glycerin. It possesses valuable antiseptic, antizymotic, antiparasitic, and deodorant properties, and, when applied to mucous or denuded surfaces, is remarkably soothing and detergent. As an agent in the antiseptic treatment of *wounds* and *ulcers,* it plays an important part, although for these purposes it has not proved so valuable as was expected on its introduction into use. When applied to raw surfaces it is less irritating than carbolic or salicylic acid or iodoform, and is entirely without danger, for no ill effects follow its absorption, as may be the case with carbolic acid. Some difference of opinion exists as to its harmlessness when taken in very large doses, but when it has been used with ordinary precautions as to quantity no ill results have ever been noted. In poisonous doses it is reported to have acted as a cardiac depressant and caused a lowering of the bodily temperature, nausea, vomiting, hiccough, ecchymoses, disturbed respiration, and coma. It may be given safely in doses of from 5 to 20 grains as often as desired, provided the aggregate during twenty-four hours does not exceed 2 drachms.

For *irrigating the peritonæum after laparotomy* it is probably safer than anything which can be used. *Ammoniacal decomposition of the urine* and *ammoniacal cystitis* are much benefitted by 10-grain doses from three to six times a day, a saturated aqueous solution being used at the same time to irrigate the bladder with. *Fermentative processes in the intestinal canal,* giving rise to *flatus* and *diarrhœa,* may be relieved by 5-grain doses after eating. Cures of *Asiatic cholera* with it have been reported, but in so grave a disorder it is hardly of sufficient value to be depended upon without other treatment. It forms the most active portion of a large number of proprietary preparations for the preservation of foods, all of which should be avoided, as their use is attended with danger. It may be established as a cardinal rule that no preservatives of any kind should be used save those which completely permeate the articles, which in themselves are harmless in large quantities, and which either form an article of food themselves or are used as condiments. So little is known of the changes which take place in the decomposition of organic matter that it is hardly safe to mask them by the use of bodies whose chief function in this connection is really that of deodorants or disinfectants. Unless the entire substance treated is reached by the preservative, putrefactive and fermentative changes are set up in the parts untouched, and the signs of those changes are disguised. The utmost that would seem allowable in the case of meats or poultry is the wiping off of the surface with a weak solution of some preservative shortly before cooking to correct the slight musty taste and odour which they sometimes acquire in warm weather from having been kept for a considerable period in refrigerators. In many localities this point has been recognised by the law, and the use of preservatives has been forbidden, more especially in the case of milk. Possibly the addition of 4 or 5 grains of boric acid to the quart of milk is allowable in cases where there may be a temporary difficulty of obtaining a fresh supply, but it should be avoided unless absolutely necessary.

Externally, the applications of this acid are almost innumerable. Powdered, it is employed in the treatment of *granular lids, ulcers, inflammation of the vagina,* and *otorrhœa.* In the last case it is blown into the external auditory canal by means of an insufflator or through a quill or tube. Used in this manner it absorbs the pus and renders it entirely inoffensive, and when saturated is washed out with plain water. The only care needed in its use in the ear is the avoidance of packing it in so tightly as to prevent the escape of the pus. Combined with vaseline or any unctuous body, it forms a salve quite as good as carbolic-acid salve, and much more elegant on account of its freedom from odour. Lister's boric-acid ointment is used extensively in the treatment of wounds, ulcers, etc. It consists of 1 part each of the acid and white wax and 2 parts each of paraffin and almond oil, reduced at the time of using to the desired consistence by the addition of glycerin. Somewhat similar to this is the official ointment of the Br. Ph., *unguentum acidi borici,* which contains 1 part of the acid to 4 parts of soft paraffin and 2 of hard paraffin. A solution in glycerin of the strength of 31 per cent. of the acid forms a desirable preparation where, for any reason, an

ointment is objectionable, and is official in the U. S. Ph. as *glyceritum boroglycerini*. This has been used with success in the treatment of *contagious ophthalmia*, *ulcers*, *burns*, and various *unhealthy suppurating surfaces*.

Some authorities regard this acid as being a perfect substitute for iodoform, but the evidence is not entirely clear, and its substitution should be practised tentatively. It certainly has the advantage of not masking any odours which might arise, as is the case with iodoform, and it would seem as if the ideal application to wounds should be entirely inodorous. Fœtor arising from a suppurating surface is not normal and may be regarded as a danger signal. In the mild forms of *conjunctivitis* and the irritation caused by overuse of the eyes a 1-per-cent. solution, preferably with the addition of a small amount of cocaine, usually affords relief if applied to the conjunctiva three or four times daily.

As an *antiparasitic*, the boroglycerite or a saturated solution of boric acid has been used successfully in the various forms of *tinea*. *Urticaria* and *pruritus* are also treated satisfactorily with these preparations. A saturated aqueous solution makes a good spray for *stomatitis*, *pharyngitis*, *nasal catarrh*, *ozæna*, and the *coryza of hay fever*.

If, when for any reason a stronger solution than can be made with simple water is desired, the addition of a bulk of borax equal to that of the acid is made, the strength of the solution can be brought up to about six per cent. Such a solution has been termed *boro-borax*. Borated lint and gauze used in antiseptic surgery are made by soaking them in a saturated aqueous solution and allowing them to dry slowly. In *gonorrhœa* a 2-per-cent. solution forms a good injection, and if used persistently will reduce somewhat the contagiousness of the pus and lessen the danger of transferring the disease to the eyes. *Fœtor of the feet* may be corrected by soaking the stockings in a saturated solution and drying them slowly, or, less efficiently, by dusting the powdered acid into the shoes and stockings. Some slight benefit has been obtained in *pulmonary tuberculosis* by 10-grain doses three times a day, and in all forms of phthisis where expectoration is profuse spraying the throat with a saturated solution is often useful.

RUSSELL H. NEVINS.

BOROGLYCERIDE.—The *glyceritum boroglycerini* described under BORIC ACID.

BOUGIES.—See under PENCILS.

BOUSSINGAULTHIA BASELLOIDES.—The root of this West Indian plant is reputed to be an efficacious remedy for *uterine hæmorrhage after parturition*. A small teacupful of a decoction of 90 parts of the root in 500 of water is given three times a day in severe cases, and once a day only in those of ordinary gravity.

BRAN.—An extemporaneous infusion of about 2 oz. of bran in a quart of boiling water, strained, is much employed as a soothing application in *eczema* and other irritative affections of the skin, also for bathing diseased areas of skin that are irritated by the contact of simple water. The infusion should be made fresh every day.

BRANDY.—See under ALCOHOL.

BRAYERA.—See CUSSO.

BROMACETANILIDE.—See ANTISEPSIS.

BROMAL, *bromalum*, *tribromaldehyde*, or *tribromacetyl oxide*, C_2HBr_3O, is a limpid oily liquid analogous to anhydrous chloral, formed by the action of bromine upon alcohol. It is colourless and of a peculiar, sharp odour and a burning, irritating taste. It is soluble in water, in alcohol, and in ether. Bromal is not official and has never been used in medicine, though its derivative, bromal hydrate, has had some slight employment.

Bromal hydrate, *bromatum hydratum*, $C_2H_3Br_3O_2$, is a crystalline solid, in every way the analogue of chloral hydrate.

Experiments upon animals show bromal hydrate, in large doses, to be a poison of great intensity, death rapidly resulting from paralysis of the heart (sometimes of the respiration) and being preceded by minutely contracted pupils, marked dyspnœa, and general convulsions. Upon the heart its action is similar to that of chloral hydrate, though considerably more marked, death resulting from paralysis of the heart in systole. By the action of bromal hydrate the irritability of both the peripheral nerve endings and the spinal nerve centres is thought to be diminished. The drug has not been much employed medicinally, for experiments upon animals do not suggest arguments for its employment in medicine in any way adequate to compensate for the great danger attendant upon its use.

Its depressing action upon the spinal ganglia and peripheral nerve endings, both motor and sensory, has suggested its employment in *convulsive diseases* and in *neuralgias*, and, though it has been given in some few cases of *chorea*, *epilepsy*, and the *lightning pains of locomotor ataxia*, the results obtained do not encourage its further employment. From a therapeutic dose there follows usually a stage of moderate excitement and then sleep, with lessening of cardiac and respiratory frequency and sometimes a moderate anæsthesia. The drug has been given in capsules in doses of from $\frac{1}{2}$ a grain to 5 grains.—HENRY A. GRIFFIN.

BROMALIN, or *bromethylformin*, $(CH_2)_6.N_4.C_2H_5Br.$, has been recommended as a substitute for the bromides. It contains only about half as much bromine, so that the dose is twice as large as that of potassium bromide. It is readily soluble in water, and seems to have certain advantages where, as in *epilepsy*, the prolonged use of bromine is prescribed, inasmuch as it is far less prone to cause acne, furuncles, and the other phenomena of bromism.

BROMAMIDE, $C_6H_2Br_3NH.HBr$, is a colourless crystalline body insoluble in water, only slightly soluble in alcohol, but soluble in ether, in chloroform, and in the fixed oils. Dr. A. Caillé (*N. Y. Med. Jour.*, Feb. 20, 1892)

has used it experimentally as an antipyretic and analgetic in *typhoid fever*, *acute articular rheumatism*, *chronic rheumatic arthritis*, *chronic nephritis*, *acute fibrinous pneumonia*, *hepatic*, *renal*, and *cardiac dropsy*, and various forms of *neuralgia*. He concludes that as an antipyretic it has the advantage of not causing excessive sweating. The dose for an adult is from 10 to 15 grains; that for a child, from 1 to 5 grains. It may be given in capsules, in wafers, dry upon the tongue, or suspended in a liquid.

BROMETHYL.—See Ethyl bromide.

BROMETHYLFORMIN.—See Bromalin.

BROMIDES.—Among the bromides, those of potassium, sodium, ammonium, lithium, and strontium are the principal ones of interest to the clinician, although the bromide of iron, usually in combination with that of sodium or potassium, in anæmia, when the bromides are indicated, and the monobromate of camphor in certain functional nervous disturbances, seem to possess some special advantages.

The effects of the bromides upon man are very much the same as upon the lower animals. They are in moderate doses sedative, in larger ones antispasmodic, and in still larger ones decidedly depressant, lessening motor and sensory response, decreasing metabolic changes, and impairing all the vital functions of the organism. Beyond a sense of unrest, nervousness, and general discomfort and a burning or uneasy feeling in the œsophagus and stomach, no stage of excitement on administering large doses of the bromides to man precedes the stage of depression, as has not infrequently been witnessed in the lower animals, amounting, according to a number of observers, to a tetanoid condition with opisthotonos.

The Mental Faculties.—The effect of the bromides on the mind is to lessen mental activity when they are given in moderate doses, and when 10 or 12 grammes (2½ to 3 drachms) are administered at once, the subject becomes drowsy and more or less apathetic. If the use of large doses is continued for a considerable length of time, mental activity becomes greatly impaired, the subject passing from a listless, apathetic condition into that of imbecility or even idiocy. As a rule, the mind soon brightens after the administration of the bromides is discontinued, but it is doubtful, if the condition simulating imbecility or idiocy has been kept up for several months by inordinate doses of the bromides, whether the mind ever regains its full power, as the condition of the brain under full doses of the bromides is anæmic, and we know that a prolonged and profound anæmia of the brain results in changes in the cells of the cortical layers.

The Motor Regions of the Brain and Spinal Cord and the Motor Nerves.—The majority of experimental investigators are agreed that the motor tracts of the nervous system, at least in the lower animals, are the last to be affected by the bromides. That the motor region of the cortex of the brain is decidedly affected by the bromides seems to be accepted from the fact that these agents have a powerful influence in lessening the convulsions in epilepsy. But we must remember that much of the influence of the bromides in modifying convulsive movements may be due to lessened irritability of the sensory portion of the nervous system.

The Sensory Nerves.—The sensory nerves are much more profoundly affected by the bromides than the motor nerves, and the peripheral ends are more affected than the nerve trunks. Partial anæsthesia of the skin and mucous membrane of the fauces is observed after a prolonged use of large doses of the bromides. In the lower animals cutaneous anæsthesia may be so marked that the faradaic current applied to the skin fails to elicit any response. but the same current placed over the nerve-trunks causes decided reflex action. One or two full doses of one of the bromides greatly diminish the normal sensibility of the fauces.

Reflex Action.—The effect of the bromides is to lessen reflex action. The cutaneous reflexes are the first to show marked diminution. The lessened reflex activity is secondary to diminished cutaneous sensibility and probably is largely due to it.

Muscular System.—Lessened muscular strength and tone are the invariable results of very large quantities of the bromides taken only for a few days, even when the amount is not sufficient to produce pronounced bromism. Ordinary therapeutic doses of from 1 to 2 drachms daily, taken for several weeks, will have the same effect. The pronounced muscular inco-ordination, especially manifest in the legs, not infrequently seen in epileptics who have taken large doses of one or more of the bromides for prolonged periods, is probably due to lessened cutaneous sensibility, muscular weakness, and impaired function of the muscular sensory nerves.

The Vaso-motor Nerves.—The vaso-motor nerves do not escape the depressing effects of the bromides, especially when they are given in large doses for prolonged periods. The experiments of Lewisky and Amory tending to show vaso-motor spasm as a result of these drugs are inconclusive, and, if they were confirmed, it would not imply that the vaso-motor nerves being stimulated by a single dose would be similarly affected by a continuous use of the bromides. The venous stasis so commonly seen in persons under the influence of these agents is largely due to the weakened condition of the heart and probably also to impaired tone of the vaso-constrictor nerves. Relaxation of the circular muscular fibres of the arterioles would allow more than the normal quantity of blood to remain in the mesenteric and cutaneous vessels, and thus, in the weakened condition of the heart and impaired nutrition, aid in the production of anæmia of the brain.

The Heart and Circulation.—The force and frequency of the cardiac beats are lessened by a large dose of the bromides, and when they are carried to their toxic effects in the lower animals the heart is arrested in diastole. The prolonged use of these drugs in man results in a weakened and irritable condition of the heart

and impaired vigour of the circulation and respiration.

The Sexual Functions.—A single large dose of one of the bromides does not seem to affect the sexual appetite materially in man, but its continued daily use for a considerable time diminishes sexual power and appetite, and if the doses are very large a person may be rendered temporarily impotent. The sexual appetite is affected alike in men and in women.

The Alimentary Tract.—The influence of the continued use of the bromides is soon observed on the organs of digestion. The tongue becomes heavily coated, the breath very oppressive, and the mouth dry; the patient complains of a bad taste and a pasty feeling in the mouth, the appetite and the power of digestion are impaired, a sense of anorexia or nausea may be experienced, and the bowels act sluggishly and irregularly; sometimes diarrhœa is observed.

Nutrition and Temperature.—On account of the depressed condition of the nervous system, lessened metabolic changes, and the interference with the organs of digestion, nutrition soon begins to suffer from the long-continued use of the bromides. A larger dose of one of the bromides will depress the temperature slightly for several hours in man, and if it is given in ordinary antepileptic doses for some time the temperature remains usually 0·5 degree or more below normal. Pallor and anæmia are due to impaired nutrition, a weakened heart, and a poor state of the blood.

Bromide Eruption.—One of the most annoying results of a prolonged use of some of the bromides is an ugly cutaneous acne-like eruption, which is usually very pronounced on the face. Fortunately, the bromide of strontium rarely causes much irritation of the skin.

Elimination.—The bromides have been found in all the liquids and most of the solids of the body. They are eliminated from the blood rather slowly and escape through the mucous membranes of the air-passages and alimentary canal and through the skin, but the kidneys are thought to be the principal organs for their elimination.

Bromism.—When the entire system becomes saturated with bromides, a condition of bromism results. It may be acute, but it is usually caused by a prolonged use of the bromides in large doses, and seems to be much more easily developed in some persons than in others. The symptoms are an intensification of the individual physiological effects of these agents into a group of morbid phenomena. Under such circumstances the subject is pale and anæmic and the body and limbs are wasted, while the face may present a swollen appearance from the acne-like eruption which usually covers the face, the shoulders, and sometimes other portions of the body. The breath is nauseatingly offensive, the tongue is heavily coated, the fauces are dry, the stomach is the seat of a catarrhal inflammation, and the bowels are torpid. The appetite is nearly lost and the power of digestion is greatly impaired. The temperature is lowered, and the hands and feet are cool and clammy. Muscular weakness is pronounced and the reflexes are lessened. All the sensory phenomena, including the special senses, are impaired. Loss of tactile sense is most marked in the fauces and on the hands and feet. The intellect is affected, the memory is poor, the mind wanders, the subject presents a silly or idiotic appearance, and he sometimes harbours delusions, though mental failure without delusions is far the most common.

Comparison of the Effects of the Different Bromides.—While there is a similarity between the general effects of the different bromides, there are differences which it is well to bear in mind in selecting a bromide for individual cases. As a cardiac depressant and toxic agent, the bromide of sodium seems to be the least powerful, and probably the bromide of potassium is the most potent. Bromide of sodium and bromide of lithium are said to have greater hypnotic power than the bromide of potassium. I am not aware that the bromide of strontium has been compared with the other bromides as to overcoming sleeplessness. My experience has been that smaller doses of potassium, lithium, or ammonium bromide will accomplish the same results as larger ones of bromide of sodium in epilepsy, but, on account of the less depressing effects following the prolonged use of the latter salt, even when pushed to obtain the same results that are effected by bromide of potassium, lithium, or ammonium, it should have the preference, as a rule, over the other salts. In the use of bromide of strontium I have had considerable experience, and have found it, as a rule, more effective in epilepsy than any of the other bromides. Bromide of strontium is the only one of the bromides that does not produce disorder of the stomach when administered for a considerable length of time. Under the use of moderate doses, digestion seems to improve and the appetite increases. Acne, so common from the other bromides, is rarely observed to any great extent from the bromide of strontium.

Therapeutic Uses of the Bromides.—In the treatment of *epilepsy* the bromides have been extensively used, and the success obtained by their intelligent employment in this disease has gained for them a deservedly high reputation. It is only infrequently that a cure can be ascribed to their influence. More commonly marked amelioration, such as lessening of the frequency and violence of the convulsions, results, and occasionally a case is met with over which they seem to exert no beneficial effect. The sooner the bromide treatment is begun after the first epileptic convulsion, the greater the probability of success. Cases of the disease of not too long a duration, in which the seizures are violent and frequent, are favourably modified by the bromides. Nocturnal attacks are less amenable to treatment than the diurnal, and *petit mal* seizures are frequently rebellious. *Hystero-epilepsy* is most favourably influenced when the attacks resemble true epilepsy. *Hysterical paroxysms*, as a rule, do not yield to the bromides, but when these agents are given in the interval between the attacks, the nervous tension and unrest are

favourably modified, and the paroxysms are not infrequently thus prevented. Much of the success in the treatment of epilepsy with the bromides depends upon the manner in which they are given. It is too much the routine treatment to give three daily doses of one of the bromides or of a combination of a number of them, regardless of the time of the occurrence of the seizure, the condition of the patient, or the form of the bromide to be employed. We should bear in mind that epileptic seizures are most favourably influenced when the greater portion of the daily quantity is given two or three hours before the time at which the fit usually occurs; that that bromide should be selected which has the least deleterious effect on the health of the patient; that no more of the drug should be given than is necessary to stop the convulsions; that the general condition of the patient should be kept as good as possible; that by the use of other agents with one of the bromides as good or better results may be accomplished with smaller doses; and, finally, that to accomplish the desired result of breaking up the epileptic habit or modifying it as much as possible, treatment must be continued for one or two years after the last convulsion. In the treatment of epilepsy the alimentary canal and the genital organs should be carefully looked after. A dose of 15 grains of antipyrine at bedtime, or a few hours before the time of the expected convulsive seizure, often enables one to keep the fits under control with much less bromide than without it. My experience with the bromides in epilepsy seems to justify the following conclusions: Bromide of strontium enjoys the first place, both on account of its efficiency in ameliorating the disease and from its less harmful effects on the patient; bromide of sodium is nearly as efficient in the treatment of epilepsy as bromide of potassium, but it is necessary to give it in larger doses; the bromides of ammonium and lithium seem to possess no special advantages over the other bromides in the treatment of epilepsy. In administering any of the bromides for prolonged periods, the condition of the patient should be kept up as well as possible. In epilepsy, from 45 to 90 grains of bromide of strontium should be given in twenty-four hours, about the same quantity of bromide of potassium, or from 60 to 120 grains of bromide of sodium, well diluted in water, after meals.

Bromide of potassium has proved very efficient in the treatment of *tetanus*. H. C. Wood (*Therapeutics, Materia Medica, and Toxicology*, 6th edition, p. 363) gives a tabulated report of thirty-four cases of tetanus, seven so-called idiopathic and twenty-seven traumatic, treated by large doses of bromide of potassium, with thirty recoveries, a mortality less than that obtained by any other method of treatment. To be of any benefit in this disease, bromide of potassium must be used in large doses, from ½ to 1 oz. in the twenty-four hours, and Wood recommends chloral to be given at night as a hypnotic. With such results one would not feel inclined to replace bromide of potassium by any of the other bromides in tetanus, except, probably, in cases of weak heart, when bromide of sodium might be substituted.

The bromides are not direct hypnotics, unless given in very large doses, but under certain conditions they act excellently in removing nervous irritation, and sleep follows. *Wakefulness* from cerebral overwork, nervous excitement and strain, anxiety, worry, nervousness, often experienced in convalescing from acute diseases, from unsatisfied sexual desire, or from functional irritation of the genital organs, is relieved by the bromides. Bromide of sodium is quite as good for this purpose as any of the others, if not better, and, as it causes but slight depression, it should receive the preference. About 15 grains should be given after each meal and 30 grains at bedtime. *Nervous irritability* and *excitement* from various causes (when not due to malnutrition and anæmia) are greatly relieved by one of the bromides given in small doses three or four times daily. The nervous unrest which comes from functional irritation of the genital organs, especially when due to ungratified sexual desire, is lessened by the bromides. They act favourably in preventing premature ejaculation during sexual congress, when the irritability is not due to weakness and malnutrition. The condition of nervousness during the early stage of *delirium tremens* is benefitted by the bromides, but later, when depression of the nervous system is apparent and the delirium well established, these agents are less potent. In most forms of *maniacal excitement* attended by increased quantity of blood in the brain the bromides, sometimes alone, but more frequently in combination with chloral, aid in calming the patient and in inducing sleep. In most states of *melancholic frenzy*, or mental agitation due to a depressed or exhausted condition of the nervous system, the remedies under consideration are either contra-indicated or afford but little relief. The congestive form of *migraine* is sometimes favourably affected by the timely administration of large doses of one of the bromides. *Neuralgia*, as a rule, does not yield to the bromides, but *ovarian pains* and the *shooting pains* sometimes experienced by plethoric persons are not infrequently relieved by them. Vaso-motor disturbances, such as sudden *numbness*, *coldness*, and *painful flushings*, are usually favourably affected by the bromides. *Reflex cough*, certain forms of *menorrhagia of nervous origin*, the *spasmodic reflex neuroses*, the gastro-intestinal disorders due to functional nervous states, especially the *vomiting of pregnancy* and various *uterine disorders*, *cholera infantum* from teething or irritability of the nerve centres, and *nervous excitement of the heart* in persons who are well nourished, have all been favourably influenced by the judicious administration of some of the bromides. Bromide of potassium has been used with excellent results in *strychnine poisoning*. "Rabuteau has proposed the use of the bromides as eliminating agents in cases of mercurial, cupric, or saturnine poisoning. These

agents, more efficiently than the iodides, combine with the deposited minerals, convert them into soluble combinations, and thus cause their elimination. The best results are probably obtained by a combination of the bromide and iodide of potassium" (Bartholow).

Administration and Dose.—The bromides should be well diluted and given after the ingestion of food. When it is desirable to administer them between regular meals, milk or some bland liquid should be taken into the stomach before swallowing the bromide solution. In cases of gastritis the bromides should be avoided if possible. Some have maintained that strong coffee taken at meals will prevent bromism in persons who are compelled to take the bromides for long periods. The dose must vary according to the object to be accomplished. In epilepsy the quantity in the twenty-four hours should be no larger than is necessary to keep the convulsions in check, usually from 1 to 2 drachms in the adult will be sufficient; in tetanus from ½ to 1 oz. may be found necessary. In cerebral congestion, in plethoric persons, 1 drachm every hour or two, until the desired object is accomplished, will not be excessive. In cases of functional nervous states in which the soothing effects of the bromides are desired the best results are gained by giving about 15 grains after each meal, and 30 grains at bedtime.

Jeremiah T. Eskridge.

BROMIDIA is an American proprietary preparation used as a calmative and hypnotic. It is said to contain in each teaspoonful 15 grains each of chloral hydrate and potassium bromide and ⅛ of a grain each of extract of hyoscyamus and extract of cannabis. The hypnotic dose for an adult is from ½ to 1 teaspoonful, and smaller doses may be used in cases of slight *cardiac* or *nervous excitement.*

BROMINE, the *bromum* of the Ph's, is a dark-brown liquid element that gives off highly corrosive and suffocative fumes. Except in chemical combination (see Bromal, Bromalin, Bromamide, Bromides, Bromoform, and Hydrobromic acid), bromine is not used internally. During the civil war Surgeon Middleton Goldsmith called attention to the use of bromine in the prophylaxis and treatment of *erysipelas, diphtheritic affections,* and *hospital gangrene.* As a prophylactic he placed vessels containing 1 oz. of a solution of 1 oz. (Troy) of bromine and 160 grains of potassium bromide in 4 oz. of distilled water in different parts of a hospital ward, using a sufficient number to secure in the apartment the constant presence of the odour of bromine. Locally, he advised the application of a piece of dry lint over which a piece of lint moistened with the bromine solution was placed; a third piece of lint spread with simple cerate covered the latter, and oiled silk was placed over all. Where there was gangrene the diseased region was first dried with charpie, thick sloughs were trimmed by means of the forceps and scissors, and the solution was applied with a pointed piece of wood or a glass rod. When the solution was effectually applied all odour from the diseased surface ceased and the sloughs hardened and gradually separated. Where there was burrowing or deep-seated gangrene the solution was injected into the part. In 308 cases of hospital gangrene treated with bromine the mortality was only 6·2 per cent., while in 26 cases in the same hospitals treated with other remedies the mortality was 50 per cent. The mortality in the total number of cases of gangrene reported during the war was 45·6 per cent., an evidence of the value of the bromine treatment in the hospitals in which it was used.

The experiments of Fischer and Proskauer showed that after an exposure for three hours in a dry atmosphere containing 3 parts of bromine vapour in 100, the anthrax bacillus was destroyed and tuberculous sputum was disinfected. Three hours' exposure to an atmosphere containing 1 part of bromine in 500 parts of moist air sufficed to disinfect any exposed material, and 1 part of bromine in 3,500 parts of air was sufficient if the exposure lasted for twenty-four hours.

N. de la Croix found that 1 part of bromine in 6,000 of water prevented the development of micro-organisms taken from a meat infusion, while in a solution of 1 to 2,500 it killed bacteria, and in a strength of 1 to 5,000 prevented the development of spores. These results are similar to those of Koch, who found that a 2-per-cent. aqueous solution of bromine destroyed spores in twenty-four hours, while a solution of 1 in 1,500 prevented the development of the anthrax bacilli.

Associated with this high power of destroying bacteria is the disadvantage that bromine affects the protoplasm of living tissue, arresting its movements.

Professor D. Hayes Agnew confirmed Goldsmith's report, and considered that no topical application had greater effect than bromine in arresting the advance of hospital gangrene.

Their reports induced the writer to make use of it in the surgical wards of several of the United States Marine Hospitals. An aqueous solution was made containing 0·4 per cent. of bromine. An unhealthy phagedenic or gangrenous wound was washed with warm water or peroxide-of-hydrogen solution, all disorganised tissue was removed by means of forceps and scissors, care being taken not to injure the granulations, and then the surface of the wound was irrigated with the bromine solution or, if the gangrene was extensive, the patient was anæsthetised and pure bromine was applied, and a compress of lint or absorbent cotton wet with bromine solution was placed on the wound, covered with oiled silk and retained in place by a bandage. This dressing was to be changed every twelve or twenty-four hours, and in from two to four days the granulation surface would be clean. Then the use of the bromine solution should be replaced by that of simple hot-water compresses, the water being sterilised or containing 1 per cent. of sodium chloride or 5 per cent. of boric acid.

In *cancer of the uterus* bromine is a very useful application, because of its deodorizing as well as antiseptic properties.

Potter has stated that bromine vapour is of value in the treatment of *nasal catarrh.*

The indications for the use of bromine in surgery are infected wounds having foul odours in which some diffusible antiseptic is required.

[Bromine is a violent corrosive poison, but fortunately one not likely to be swallowed in its pure state. In cases of its ingestion into the stomach, either pure or in such a strong solution as to be caustic, the bicarbonate or carbonate of sodium or potassium should be administered, and afterwards white of egg, starch, or gelatin. A commoner form of bromine poisoning is due to the inhalation of its fumes, causing great irritation of the air-passages, with a sense of suffocation. In such cases, if treatment can be brought to bear promptly enough, while yet some of the bromine fumes may linger in the respiratory passages, further damage may in a measure be prevented by resorting to the cautious inhalation of ammonia; but at a later stage this procedure would do harm instead of good, and the inhalation of steam should be substituted for it.]—Samuel T. Armstrong.

BROMOFORM, CHBrz, is an oily, sweet, colourless liquid, with an ethereal odour and a specific gravity two and a half times as great as that of water. It is made by the action of bromine on alcohol in the presence of an alkali. It is quite soluble in ether and in alcohol, but on account of its oily nature does not readily mix with water. Nunnely and Schuchard called attention to bromoform as a possible anæsthetic in 1849, and Rabuteau brought it forward as a new anæsthetic in 1869 (Fischer).

Bromoform is capable of relieving *nervousness* like the other bromides. Its effect in small doses is stimulating and soothing; in larger ones it diminishes or abolishes the functional activity of the reflex centres and produces sleep and insensibility to pain. In toxic doses it causes collapse, from which death may result, apparently from cardiac and respiratory paralysis.

Bromoform is believed to be a more dangerous *anæsthetic* than ether or chloroform, and it is probable that it will never be extensively used for this purpose. It was in the treatment of *whooping-cough* that Stepp first called attention, in 1889, to this drug as a valuable therapeutic agent. He reported a hundred cases of moderate severity in which the remedy acted without a failure in shortening the duration and lessening the violence of the disease. Whooping-cough under this treatment ran a course of from two to four weeks, but the paroxysms began to ameliorate and became less frequent after two or three days' treatment. Löwenthal reported a hundred cases treated in Senator's clinic in Berlin, with excellent results. The good effects of the remedy were observed within two or three days after the first dose. Dr. Louis Fischer, of New York, has treated fifty-one cases of whooping-cough with bromoform and obtained most gratifying results. Schippers has employed bromoform in two hundred and fifty cases of whooping-cough, and concludes that in therapeutic doses it is a harmless agent, diminishing the number and severity of the paroxysms, shortening the duration of the attack, and preventing vomiting and nasal hæmorrhage. Dr. Fischer and others think bromoform favourably modifies the complications of whooping-cough. Cassel and Ullman have found that the remedy under consideration diminishes the number and severity of the paroxysms, but does not shorten the duration of the disease. Dr. H. B. Carpenter, of Philadelphia, reports cases of whooping-cough treated with bromoform, with good results in some and no effects in others. We may conclude that, while the use of this new claimant for favour in the treatment of whooping-cough is not invariably attended with decided benefit, it is probably the most efficient and reliable agent which we have at present.

Bromoform has been used in such spasmodic affections as *asthma*, *singultus*, and *laryngismus stridulus*, but not with very pronounced or invariable success. Bartholow recommends the subcutaneous injection of 5 minims to abort an attack of asthma. The same author reports good effects from bromoform in *headache* and *vertigo from reflex causes*, and especially in the neurasthenic, and says: "In certain cases of intestinal catarrh with reflex vertigo and occipital headache it has apparently done much good. It remains to be seen whether bromoform will take the place of any of the other bromides of an alkaline base. So far I have found it a very uncertain remedy in reflex headache; sometimes it succeeds, but more frequently it fails."

Dose and Administration.—To a child a year old from 1 to 3 minims may be given thrice daily; to one from two to four years old from 3 to 6 minims; to adults from 10 to 15 minims. The dose for an adult may be gradually increased to twice or three times the size here given and no unpleasant effects will result. To children it is conveniently administered in a spoonful of water, but, as the medicine sinks to the bottom of the spoon, care must be exercised that it is certainly swallowed. Syrup of acacia or an alcoholic solution may be employed as a vehicle for bromoform. To those who dislike the odour it may be administered in capsules. Bromoform should be kept in a dark place, enclosed in a dark and well-closed bottle, as it changes readily on exposure to sunlight. Only two or three doses should be mixed at a time. When the medicine presents any colour, free bromine has formed, and it should be discarded.

Jeremiah T. Eskridge.

BROMOL, or *tribromphenol*, $C_6H_2Br_3OH$, obtained by the action of bromine on phenol in aqueous solution, occurs in silky crystals insoluble in water, but readily soluble in alcohol, ether, chloroform, glycerin, or oils. It has a sweetish, astringent taste and a peculiar but not disagreeable odour. Applied in substance to the unbroken skin, it has no effect, but on mucous surfaces and denuded parts it acts as a mild caustic. It has been used as an antiseptic application to *wounds* and *ulcers* and to the throat, etc., in cases of *diphtheria*. For these

purposes it may be made into an ointment with vaseline (1 drachm to 1 oz.) or dissolved in oil or glycerin in the 1 to 30. It has been recommended by Dr. Rademacher, of Louisville, as an internal antiseptic in *typhoid fever* and *cholera infantum*, and has been used in *pulmonary abscess*, in doses of $\frac{1}{4}$ of a grain once or twice daily for adults and proportionately smaller doses for children. It is best administered in capsules. According to Dr. Cerna, bromol has recently been recommended for the expulsion of *tapeworm*, especially the *Tænia mediocanellata* and *Bothriocephalus latus*.

BROUSNIKA. — The *Vaccinium Vitis idæa* (see under VACCINIUM).

BRUCINE is an alkaloid obtained from *Strychnos Nux vomica*. It has the same medicinal properties as strychnine, but in a lesser degree.

BRYONIA.—A genus of cucurbitaceous plants. The bryonia of the U. S. Ph. is the root of *Bryonia alba* and that of *Bryonia dioica*. Bryony is purgative and diuretic. It has been recommended in the treatment of *whooping-cough*, in various *inflammations*, especially those of the *serous membranes*, in *rheumatism*, and, especially *Bryonia alba*, as a hæmostatic in *hæmoptysis*, *hæmatoma*, and *post-partum hæmorrhage*. Bryony contains an alkaloid, *bryonine*, and a glucoside, *brein*. It is to brein that the hæmostatic properties of the plant are attributed. The powdered root may be given in daily amounts of from 8 to 75 grains. The dose of the tincture, *tinctura bryoniæ* (U. S. Ph.), is from 1 to 2 teaspoonfuls.

BUCHU (U. S. Ph.), *buchu folia* (Br. Ph.), consists of the leaves of *Barosma betulina* and *Barosma crenulata*, shrubs of southern Africa. Taken by the mouth, buchu by virtue of its taste acts moderately as a bitter, improving appetite and digestion and often producing a feeling of warmth in the stomach. These results, however, follow only the smaller and therapeutic doses; larger doses are productive of gastric and intestinal irritation, as is shown by nausea, vomiting, and diarrhœa. Absorbed into the blood, buchu is eliminated slightly by the skin and the bronchial mucous membrane (in fact, by the mucous membranes generally), but principally by the kidneys, its presence in the urine being made manifest by imparting to that fluid its peculiar aromatic odour. In passing through the kidney it exerts upon that organ a stimulant effect, for, though its diuretic action is but slight, yet to some extent it increases both the fluids and solids of the urine. Its prolonged use or its use in excessive doses is believed to be the cause of renal irritation and inflammation at times.

Passing from the body in the urine, it produces on the mucous membrane of the urinary tract those effects for which it is mainly employed in medicine. These effects are purely local and may be described as stimulant, tonic, and slightly astringent. In thus stimulating the urinary mucous membrane its action is similar to that of turpentine, though much milder and more soothing. From this, then, it will be seen that buchu, though indicated in the relaxed and atonic condition associated with a subacute or a chronic inflammation of the urinary tract, is as distinctly contra-indicated if that inflammation is acute.

As has been said, the main use of buchu is in subacute and chronic *catarrhs of the urinary mucous membranes*, *pyelitis*, *cystitis*, and *urethritis*, and in such cases it is often of the greatest service.

In *chronic vesical irritation*, too, it is of great value, and in that condition of vesical irritation due to highly concentrated and acid urine its employment, either alone or, better yet, combined with sweet spirit of nitre and with acetate or citrate of potassium, will be productive of much benefit.

Though slightly diuretic and at times used in the treatment of *dropsies*, buchu for this purpose is inferior to other drugs and is not to be recommended.

The fluid extract, *extractum buchu fluidum* (U. S. Ph.), is made by macerating and percolating the powdered leaves with alcohol and diluting with alcohol to the required standard. The dose is from 20 to 60 drops. In administering buchu the fluid extract is to be employed in preference to the powdered leaves or the infusion, and may be given three or four times a day largely diluted with water. The infusion, *infusum buchu* (Br. Ph.), made with 1 oz. of the leaves to 1 pint of boiling distilled water, is much used in doses of from 1 to 2 tablespoonfuls. The tincture, *tinctura buchu* (Br. Ph.), is made with $2\frac{1}{2}$ oz. of buchu to 1 pint of proof spirit. The dose is from 1 to 2 teaspoonfuls.

The powdered leaves are themselves occasionally given in doses of from 20 to 30 grains.

HENRY A. GRIFFIN.

BUCKTHORN.—See RHAMNUS.

BUENA.—See CASCARILLA.

BURDOCK.—See LAPPA.

BUTTERNUT.—See JUGLANS.

BUTYL-CHLORAL HYDRATE, *croton-chloral hydrate*, $C_4H_5Cl_3O, H_2O$, is formed by the action of chlorine gas on ethyl aldehyde. It occurs in white crystals having a flavour resembling that of melons. It is not official. Its physiological and toxicological actions are similar to those of chloral hydrate, but as a hypnotic it is less reliable. It has in addition, however, the singular property of causing anæsthesia of the head and face, and to this action is mainly due its use in medicine. In *facial neuralgia* the drug is often of great service, sometimes in so small a dose as 2 grains, though generally more is required. In other conditions it is far less serviceable, though some have thought it beneficial in *sciatica*, *dysmenorrhœa*, and *cough*.

It may be given in doses of from 2 to 15 or even 20 grains, but it is better to administer it in doses of from 3 to 5 grains and repeat the dose at intervals of one or two hours until 15 grains have been taken. It is only slightly soluble in water, but may be given largely

diluted in it, dissolved in glycerin and syrup or in pill form with glycerite of tragacanth.
HENRY A. GRIFFIN.

BUXINE.—An alkaloid obtained from *Buxus sempervirens*, identical with bebeerine.

CACAO-BUTTER, *oleum theobromatis* (U. S. Ph., Br. Ph.), is a fixed oil expressed from the seed of *Theobroma Cacao* (see COCOA). It occurs as a yellowish-white solid which becomes white with age. It has a faint, agreeable odour, a bland, cocoa-like taste, and a neutral reaction. It melts at between 86° and 95° F. It is a complex fat, being a glycerin combined with oleic, stearic, palmitic, and several other fatty acids. It is a perfectly bland, unirritating fat. It was introduced into the U. S. Ph. in 1860 chiefly because of its value as a base for suppositories.

It is rarely used internally for medicinal purposes, although it occurs as the most valuable ingredient of the various cocoa food preparations. Externally, it is used as an emollient and protective. [Inunction with cacao-butter, as with any other bland fat, exerts a tranquillizing and slightly antipyretic action. Hence, in cases of *fever* of moderate severity, especially in young children, the smearing of this fat over the body serves to reduce the temperature and to allay the discomfort.] It has been advised by Wood as a useful vehicle for the application of drugs to the nasal passages. It enters into the composition of numerous cosmetic ointments. The following is an elegant and bland ointment useful in various conditions: Melt together 4 oz. of yellow wax and 28 oz. of cacao-butter; add 1 drachm each of balsam of Peru and benzoic acid; mix and pour into moulds. Perfuming oils may be added if desired and, when the mixture is almost cool, 1 oz. of glycerin.

The most important use of cacao-butter is in making suppositories. Owing to the fact that it melts just below the temperature of the body, it is especially adapted to this use, and has now almost superseded all other substances for this purpose. In the preparation of suppositories, the medicinal portion, having previously been brought to the proper consistence, is mixed with a small quantity of cacao-butter which has been melted and cooled to the temperature of 95° F. They are then mixed thoroughly without applying more heat, and poured into suitable cold moulds. Unless otherwise specified, rectal suppositories weigh 15 grains; pencil-shaped urethral suppositories, 15 grains; and vaginal suppositories, 45 grains. Cacao-butter is also occasionally used by pharmacists as an excipient for pills.

Cacao-butter is frequently adulterated with tallow, paraffin, and other cheap oils and fats. It is especially important that it should be pure when used for suppositories. The melting point of most of these oils is above the temperature of the body. If they enter into the composition of the suppository they render it comparatively insoluble and almost worthless.

Rectal medication is resorted to for the purpose of producing either local or constitutional effects. When the stomach becomes irritable, or in conditions in which medicines cannot be introduced into that organ, rectal medication becomes very important. Absorption is in most cases slow. The mucous membrane readily becomes irritated and cannot, as a rule, be relied upon in long-continued illness. In *diseases of the rectum* astringents, antiseptics, and sedatives are employed for their local effect. *Pelvic pain* due to dysmenorrhœa, disease of the uterus or ovaries, or inflammatory conditions, is relieved more effectually by medicine administered by the rectum than by the stomach. Salts of the alkaloids, especially morphine and atropine, are absorbed as readily as by the stomach. Mineral salts are absorbed sparingly and have a local effect alone. As the secretions of the rectum are alkaline in reaction, drugs which require an acid for their solution are absorbed slowly, but the addition of acid quickly causes irritation. Rectal medication is effected by means of injections, ointments, and suppositories. The latter are, as a rule, the most convenient. The following drugs are those most frequently used for this purpose, with the amount which may be administered in each suppository: Opium, morphine, extract of belladonna, atropine, strychnine (dose, the same as when administered by the stomach or a little larger); tannic acid, 2 to 5 grains; lead acetate, 2 to 4 grains; zinc sulphate, ½ to 1 grain; ergotine, 2 to 5 grains; iodoform, 2 to 5 grains; bismuth, 2 to 5 grains; asafœtida gum, 5 to 8 grains; quinine, 3 to 5 grains; cocaine, ¼ to ½ grain; balsam of Peru, 1 to 3 drops; carbolic acid, ½ to 1 drop; fluid extract of hydrastis, 3 to 5 drops; boroglyceride, 3 to 5 drops.

Laxative suppositories are sometimes made containing aloin and podophyllin. Glycerin suppositories have a very active cathartic effect, and have been largely used during recent years. Their often repeated use is likely to cause serious irritation of the mucous membrane. They are made as follows: Glycerin, 900 grains; sodium carbonate, 45 grains; stearic acid, 75 grains, to make ten suppositories.

Vaginal suppositories are of three times the size of those designed for rectal use. As the vaginal mucous membrane is much less sensitive than the rectal, a greatly increased amount of the medicinal agent may be employed. The following drugs are chiefly used for this purpose: Carbolic acid, 2 to 3 grains: bismuth, iodoform, boric acid, zinc oxide, zinc sulphate, lead acetate, each 5 to 10 grains; fluid extract of hydrastis, boroglyceride, each 5 to 10 minims.

Various trade preparations designated as suppositories are in the market. Some of these are really capsules and are fairly reliable, but others are made so hard to insure their preservation for a long period of time that they are insoluble and practically worthless. These preparations are, almost without exception, far inferior to suppositories freshly made upon the physician's prescription.

[For a peculiar use of cacao-butter in the treatment of persistent muscular spasm, see under COCA AND COCAINE.]—FLOYD M. CRANDALL.

CACTINE, *cactina*, is a proximate principle, supposed to be an alkaloid, obtained from the night-blooming cereus (*Cactus* or *Cereus grandiflorus*). It seems to be the active principle of the plant, and Dr. O. M. Myers, of Rochester, who has experimented with it, thinks its use preferable to that of cactus. The maximum amount to be given in twenty-four hours is set down by M. Bocquillon-Limousin as 0·077 of a grain. (See CEREUS GRANDIFLORUS.)

CACTUS GRANDIFLORUS.—See CEREUS GRANDIFLORUS.

CADMIUM.—Most of the salts of this metal are white and have a disagreeable metallic taste. According to Dr. Blake, they kill by arresting the action of the heart. According to Kobert, the physiological action of the cadmium salts does not effect the irritability of a muscle, but diminishes the total amount of work it is able to do. Brunton has found that they cause slight contraction of the blood-vessels.

The most exhaustive investigations regarding the action of these salts are those made by Professor W. Marmé in 1866 and 1867. His results proved that the sulphide was not poisonous, as Hasselt had stated, for a number of drachms were administered to animals, with their food, for a week without producing any evil effect. The insolubility of this salt in water, in dilute acids, in alkalies, and in oils, makes its use as a pigment free from danger.

Cadmium Poisoning.—The compounds of cadmium that are soluble in water and in dilute acids at the normal temperature of the body, or are convertible into soluble salts, are all poisonous. Experiments have been made with the oxide, the oxyhydrate, the chloride, the potassio-chloride, the ammonio-chloride, all the corresponding compounds of bromine and iodine with cadmium, and the sulphate, nitrate, carbonate, acetate, tartrate, and lactate.

The local action of these poisonous compounds always caused irritation, which was more or less considerable according to the quantity. When introduced into the stomach in small doses, these substances produced vomiting, and in large quantities repeated vomiting and diarrhœa, and also gastro-enteritis, from the simple catarrhal up to the ulcerative form. Perforation did not occur, even after the use of concentrated solutions of the chloride. Hypodermic applications produced, according to the amount and degree of concentration of the solutions, either simple circumscribed hyperæmia or an exudation process which sometimes resulted in suppuration. The remote action of these compounds produced symptoms similar to those observed by Soret in men poisoned by inhalations of carbonate of cadmium; these were vertigo, vomiting, diarrhœa, slowness of the circulation and respiration, loss of strength, loss of consciousness, and cramp. The last symptoms were sometimes followed in animals by death. In sucking animals, birds, and amphibia the heart's action generally outlasted the respiration, although this might be for a short time only.

If quantities sufficiently large to be poisonous without causing death directly were injected into the subcutaneous cellular tissue or the blood-vessels, they excited an inflammatory irritation of the mucous membrane of the stomach and intestines, and frequently even hæmorrhage, erosion, and ulceration. The cadmium salts, when injected in small quantities into the blood-vessels, are fatal; 0·46 of a grain is sufficient to kill a hound, 0·30 of a grain a cat, and from 0·15 to 0·30 of a grain a small dog. Subcutaneous injections of twice or three times these quantities produced similar results. The introduction of from 0·46 to 0·92 of a grain into the stomach of a small dog caused death. As hounds, cats, and pigeons immediately vomited a part of the poison, the fatal dose remains undetermined. The subsequent injection of large quantities of a dilute solution of soda, or soda water, when employed early, completely arrested the poisonous action of the preparations of cadmium. In cases of acute poisoning the carbonates of the alkalies with white of egg act as the best antidotes.

The continued absorption of small doses of the soluble salts or oxyhydrates of cadmium caused chronic poisoning, which in animals was characterised by disturbed digestion and emaciation, and ended in death. At the autopsy, more or less extensive gastro-enteritis was found, sometimes subpleural ecchymosis, partial congestion of the lungs, and frequently fatty degeneration of the liver and cardiac muscular tissue, and diffuse inflammation of the kidneys.

The local action is explained by the influence of the cadmium salts upon the albuminates. The remote action, or the absorption of the salts essential to its production, can be accomplished the more readily, as the albumin precipitated is partly soluble in an excess of the precipitating agent, especially in a solution of the double salt, such as the chloride of cadmium and sodium, and also in solutions of the alkaline chlorides. These albuminates of cadmium dissolved by an alkaline chloride, when injected into a vein, the subcutaneous areolar tissue, the peritoneal cavity, or the stomach, produced symptoms exactly resembling those described above. The iodide of cadmium when absorbed as such possessed some slight affinities to many tissues of the body; it also coagulated the albuminates. The chlorides do not, however, combine with any element of the body. The elimination of cadmium begins soon after its introduction, and takes place, with interruptions, chiefly if not exclusively through the kidney.

Dr. G. A. Wheeler has reported two cases of poisoning by cadmium bromide taken, in doses between 8 and 16 grains, instead of ammonium bromide. The symptoms were similar to those produced by the other cadmium salts. Both patients recovered. Palmer has reported a case of poisoning by cadmium chloride.

Cadmium bromide, $CdBr_24H_2O$, is a colourless, soluble salt made by digesting the metal with bromine in water. Roux has administered it internally in the treatment of *epilepsy*, but it had no effect on the disease, and caused vomiting.

[**Cadmium salicylate,** $(C_6H_4OHCO_2)_2Cd + 3H_2O$, has been recommended as an astringent and antiseptic in the treatment of *keratitis, purulent ophthalmia*, and *gonorrhœa*, in a solution of 4 grains to the ounce for the eye and of 5 grains to the ounce for injection into the urethra or vagina.]

Cadmium sulphate, $CdSO_4$, occurs in large, colourless, monoclinic, soluble crystals that have the composition $3CdSO_4 + 8H_2O$. It is prepared by dissolving 2 parts of metallic cadmium and 2 parts of sulphuric acid in 10 parts of water; the cadmium is more rapidly dissolved if it is first combined with from 1 to 1¼ part of nitric acid; the hydrate is precipitated from the nitrate by sodium hydrate and then dissolved in sulphuric acid. Combined with the sulphates of the alkalies and the alkaline earths, cadmium sulphate produces double salts.

It is an astringent and emetic, and is said to be more powerful than zinc sulphate. As an emetic it may be given in doses of from 2 to 8 grains. As an astringent it has been used in *acute* and *chronic ophthalmia, gleet*, and *otorrhœa*, and in *ulcer of the cornea*. As a collyrium in ophthalmia the strength is from ½ to 3 grains in distilled water. Fronmüller used in corneal ulcer:

℞ Cadmium sulphate ... 3 grains;
Tincture of opium.... from ½ to 1 dr.;
Rose water.......... 1½ oz.

Gazeau has asserted that it is superior to zinc sulphate in the treatment of *blennorrhœa*, in a solution of from 1 to 1,000 to 1 to 500, injected every two hours. Cadminm sulphate (*sulfas cadmicus*) is official in the Fr. Cod., but none of the salts of cadmium are official in the U. S., Br., or Ger. Ph., and none of them are much used.—Samuel T. Armstrong.

CÆSALPINIA.—See Bonduc.

CAFFEINE, or *coffeine, caffeina* (U. S. Ph., Br. Ph.), *coffeinum* (Ger. Ph.), also known as *theine*, $C_8H_{10}N_4O_2 + H_2O$, is "a feebly basic proximate principle obtained from the dried leaves of *Thea sinensis* or from the dried seeds of *Coffea arabica*, and found also in other plants." It occurs in "fleecy masses of long, flexible, white crystals, possessing a silky lustre, without odour, having a bitter taste, and permanent in the air." It is "soluble at 15° C. (59° F.) in 80 parts of water, 33 parts of alcohol, 555 parts of ether, or 7 parts of chloroform, also soluble in 9·5 parts of boiling water, and very soluble in boiling alcohol" (U. S. Ph.).

Caffeine itself is comparatively seldom employed in medicine. The dose is from ½ grain to 5 grains, and the maximum amount to be given in twenty-four hours is 20 grains.

Citrated caffeine, caffeina citrata (U. S. Ph.), *caffeinæ citras* (Br. Ph.), is a "white powder, odourless, having a purely acid taste and an acid reaction." The U. S. preparation is made by dissolving 50 grammes of citric acid in 100 c. c. of hot distilled water, adding 50 grammes of caffeine, evaporating to dryness, and powdering finely. The Br. Ph. orders 1 oz. each of caffeine and citric acid and 2 oz. of distilled water; the acid to be dissolved in the water, the solution heated, and the caffeine stirred in. This preparation is the one most used in medicine, and is sometimes referred to as "citrate of caffeine," though strictly speaking this is incorrect, since it is merely a mixture and not a salt. The dose is from 1 to 5 grains.

Effervescent citrated caffeine, *caffeina citrata effervescens* (U. S. Ph.), is made by triturating together 10 parts each of caffeine and citric acid, 330 of sodium bicarbonate, 300 of tartaric acid, and 350 of sugar, making the powder into a paste with enough alcohol to make 1,000 parts, passing the paste through a No. 6 sieve, drying it, and reducing it to a coarse powder. It must be kept in well-stoppered bottles. The dose is from 1 to 3 drachms.

Certain unofficial salts of caffeine are employed in medicine. The most important are the hydrobromide, the sodio-salicylate, and the sodio-benzoate. The two last have the advantage of being sufficiently soluble and non-irritating to be administered hypodermically. For hypodermic injection, Tanret recommends the following solution: Salicylate of sodium, 31 parts; caffeine, 40 parts; distilled water, 60 parts. Huchard uses benzoate of sodium, 45 grains; caffeine, 30 grains; distilled water, 1½ drachm.

The physiological action of caffeine and its salts is a decided one, especially upon the nervous system, the circulation, and the kidneys. Upon the brain, caffeine, in therapeutic doses, exerts a stimulant power, producing wakefulness, greater capacity for work, and increased activity of thought. Increased reflex excitability, too, follows its administration, from stimulation of the spinal centres, and tremors may be observed.

The heart's action is very much strengthened by the therapeutic administration of caffeine. At first it is slowed, but afterwards it becomes more rapid and at times irregular. The cause of these phenomena is not determined: some think them due to a direct action on the heart muscle, while others ascribe them to nerve stimulation. The general blood-pressure is increased, probably on account of the increase in cardiac force only. The effect of caffeine upon the circulation is comparable to that of digitalis, but it comes on more quickly and disappears more rapidly than that of digitalis.

Caffeine is a true diuretic, increasing both the solids and the liquid of the urine, and by a direct action upon the renal epithelium.

Caffeine, when given in therapeutic amount, is not eliminated from the body, but is completely destroyed. Upon the body generally it appears to act in preventing tissue waste.

Though *poisoning* from this drug is rare, yet cases have been reported. The usual symptoms are dizziness, irritability, tremors, and constant motion, great increase of the amount of urine passed, circulatory excitement with rapid pulse, and, in some cases, collapse. The mind is almost invariably clear. The treatment of this condition is symptomatic, and sedatives and stimulants must be administered according to the necessities of the case. If the patient is seen sufficiently early the stomach is to be emptied. A disagreeable result of the thera-

peutic use of caffeine is seen occasionally in the production of insomnia and restlessness.

The action of caffeine upon the circulation and the kidneys makes it a drug of the greatest value in the treatment of *dropsy*, whether of cardiac or of renal origin. In these conditions it has its most important applications, and should be administered three or four times a day. As a diuretic it is generally very reliable in increasing the amount of urine, and in *chronic nephritis*, especially with a weak or a failing circulation, it may be used freely. In *acute inflammation of the kidney* it is, however, usually contra-indicated.

In *organic disease of the heart* caffeine may be used to fulfil the same purpose as digitalis, and though its action is both more rapid and more evanescent, yet as a substitute for digitalis it is often excellent, and it has the great advantages of being more decidedly diuretic, less irritating to the stomach, and possessed of no cumulative action.

[Dr. E. Markham Skerritt (*Practitioner*, Apr., 1895, p. 318) regards caffeine as an antispasmodic of considerable value and as the best remedy we have for the paroxysms of *spasmodic asthma*. Ordinarily, Dr. Skerritt orders 5 grains of citrated caffeine to be taken every four hours until the bronchial spasm is relieved. He thinks the drug is more likely to prove effectual in adults than in children, and most of all in adults whose attacks come on early in the morning. From 5 to 10 grains taken at bedtime, he says, will often suffice to avert the paroxysm in such cases.]

In *headache*, the result of nervous exhaustion, and in *migraine*, the administration of caffeine is of great service. It may be given in small doses and repeated at frequent intervals until effective. The *caffeina citrata effervescens* is especially agreeable for these conditions, and should be given in a small amount of cold water. Combinations of caffeine with antipyrine, too, are often most serviceable in *nervous headache* and in *migraine*, as is the popular remedy tea, by virtue of the caffeine it contains. Combined with a bromide, caffeine acts well in such cases, a circumstance which explains the popularity of certain proprietary preparations.

Caffeine will at times diminish the pain of *neuralgia*, but is scarcely to be depended on for this purpose. Its use in *opium poisoning*, as a stimulant to nerve activity, is of the utmost value, and there seems to be some advantage in giving the drug in the form of strong black coffee. (See Coffee.)

That caffeine will stimulate an exhausted and overworked brain and nervous system to renewed efforts is undoubtedly true, but in so doing it makes the subsequent exhaustion the greater. For mental and bodily fatigue, then, caffeine is in no way a substitute for rest, and should not be used save for the briefest periods and in the greatest necessities.

Henry A. Griffin.

CAHINCA, CAINCA, the root-bark of the Brazilian plant *Chiococca racemosa*, a violent emeto-cathartic, was formerly in repute as a remedy for *dropsy*, but is now little used. *Cahincic acid*, or *cahincin*, which is one of its constituents, has been given in doses of from $1\frac{1}{2}$ to $2\frac{1}{2}$ grains twice a day.

CAJEPUT, CAJUPUT.—Oil of cajuput, *oleum cajuputi* (U. S. Ph., Br. Ph.), is a volatile oil distilled from the leaves of *Melaleuca Leucadendron*, a myrtaceous plant. It is employed, both internally and by topical application, as an antispasmodic, anodyne, and stimulant in *colic*, *dysmenorrhœa*, *rheumatism*, and *neuralgia*. For its internal administration the *spiritus cajuputi* of the Br. Ph., a solution of 1 fl. oz. of the oil in 49 fl. oz. of rectified spirit, is convenient, and may be given in doses of from $\frac{1}{2}$ to 1 fl. drachm. The oil is one of the ingredients of the *linimentum crotonis* of the Br. Ph.

CALABAR BEAN.—See Physostigma.

CALAMINE, *calamina* (Br. Ph.), or *lapis calaminaris*, is a native zinc carbonate (see under Zinc). Calamine is also the name applied by Thomas to an alkaloid obtained by him from the rhizome of *Acorus Calamus*.

CALAMUS (U. S. Ph.), *rhizoma calami* (Ger. Ph.), is the rhizome of sweet flag, *Acorus Calamus*. It is reputed carminative, stomachic, and tonic. A hot infusion of the strength of 1 oz. to 1 pint, in doses of a wineglassful, is often efficient in *flatulent colic*. The fluid extract, *extractum calami fluidum* (U. S. Ph.), may be given in doses of from 5 to 15 drops in *flatulence* and *atonic dyspepsia*.

CALCARIA CHLORATA (Ger. Ph.).—Chlorinated lime.

CALCARIA USTA (Ger. Ph.).—Burnt lime.

CALCIUM.—The effects of the salts of this base seem to depend greatly upon the acids and elements with which it combines, and perhaps upon qualities inherent in the salts themselves. The properties, however, of promoting constructive metabolism, when they are used in small doses, and of destructive metabolism in large doses, are common to them all in a greater or lesser degree. The oxide, the hydrated oxide, the carbonate and the salts of the vegetable acids have the same general effects as those of the stronger alkalies, but in a much smaller degree. But small amounts are absorbed, all excess passing off through the intestines in which it may form troublesome concretions. In addition to the salts requiring more special notice there are several employed in medicine, such as the *benzoate* and *hippurate*, used in 10-grain doses in *lithæmia* and *strumous affections;* the *iodate*, employed in solution for irrigating the bladder in *cystitis;* and the *salicylate* and *sulphocarbolate*, employed in the same manner and doses as the corresponding sodium salts. (Cf. Lime.)

Calcium bromide, *calcii bromidum* (U. S. Ph.), $CaBr_2$, has the same general effects as the bromides of ammonium, lithium, potassium, and sodium. It is said, however, that it is rather more effectual in relieving the *insomnia* due to worry and overwork and the general ir-

ritable condition of *hysterical women.* It has been recommended by Germain Sée as a sedative in *typhoid fever.* Some patients with *epilepsy* seem to be more benefited by this salt than by the other bromides, but, as there are no symptoms by which this particular form can be distinguished, it is well to begin the treatment with this salt in all cases where the bromides seem indicated. It may be given in doses up to 2 drachms, with a carminative and a large amount of water.

Calcium carbonate.—See CHALK.

Calcium chloride, $CaCl_2$, *calcii chloridum* (U. S. Ph., Br. Ph.), is a highly deliquescent salt, used in various pharmaceutical and chemical processes for the absorption of moisture from substances and from receptacles where a dry atmosphere is desired. In medicine it has come into notice from time to time as a *preventive of suppuration* and has as many times fallen into disuse, more on account of the extravagant statements made in its behalf than for any real lack of efficiency. There is not the slightest doubt that in many instances it will abort *furuncles*, but its most marked effect is the relief of the *acne* of individuals of either sex at the age of puberty. Unfortunately, it is impossible to determine in what classes of cases of these affections it will be useful, but in the doses appropriate for those conditions, from $\frac{1}{8}$ to $\frac{1}{4}$ of a grain three times daily, it is entirely harmless unless its use is too protracted. All *strumous cutaneous affections*, especially *lupus*, are often benefited by its employment. The *caries* and *necrosis* of the same diathesis, *rickets*, *indurated glands*, and *tabes mesenterica* are also conditions in which it may be employed with some expectation of benefit. It is also reputed to calcify *tubercular deposits* and hasten the cicatrization of ulcerating cavities. In *acute lobar pneumonia* it has been given in 5- to 15-grain doses every four hours, but upon what grounds it is difficult to understand. *Ovarian* and *uterine tumours* are reported to have decreased in size under its long-continued use—a result obtained probably by the calcification of the arteries distributed to them; but, as there is no certainty that this effect will be limited to the vessels of the morbid growth, it is not a very desirable method of treatment. In excessive doses calcium chloride is a powerful irritant cathartic. Soap and sodium sulphate are the appropriate antidotes. On account of its deliquescent properties it can be used only in solution. The *liquor calcii chloridi* of the Br. Ph., which contains 88 grs. in the fl. oz. of distilled water, is as convenient a preparation as any, but it should be made fresh, as it is apt to undergo changes. The dose of this preparation is from 5 to 50 drops. In general, nothing will be gained by the administration of doses larger than 1 grain three times daily, and probably it should be given for periods not longer than three weeks, at the end of which its use should be intermitted for a week, as there is always the possibility of giving rise to calcareous deposits in the arteries, if it is used without judgment.

Calcii hydras (Br. Ph.).—Slaked lime (see under CALX and LIME).

Calcium glycerinophosphate, the formula of which is said to be $CaC_3H_7PO_6$, has recently been recommended in certain nervous affections. Enough is not yet known of its action to warrant any further statement here concerning it.

Calcium hypophosphite, *calcii hypophosphis* (U. S. Ph., Br. Ph.), $Ca(PH_2O_2)_2$, is not often used by itself. The syrup of the hypophosphites (see under PHOSPHORUS) possesses all its properties and is a more eligible preparation, but if it seems desirable to use the salt by itself, it may be given in 10- to 30-grain doses.

Calcium hyposulphite or *thiosulphate*, $CaS_2O_3 6H_2O_2$, has the same general effects as the other hyposulphites. It is used in doses of from 10 to 20 grains, or from 2 to 4 fl. drachms of an unofficial syrup.

Calcium iodide, CaI_2, is employed in the same manner and the same doses as potassium iodide, but is regarded by some as being better tolerated and less apt to disorder the digestion. It is sometimes prescribed in the form of a syrup. (See under IODINE.)

Calcium phosphate, $Ca_3(PO_4)_2$, *calcii phosphas præcipitatus* (U. S. Ph.), *calcii phosphas* (Br. Ph.), *calcium phosphoricum* (Ger. Ph.), is obtained principally from bone ash. Upon theoretical grounds it has been awarded a rather higher position as a therapeutical agent than it is really entitled to, but is yet of considerable value in the treatment of conditions in which there is a *deficiency of lime and phosphorus.* It is believed to promote the rapid formation of callus in *fractures* and to hasten the cure of *scrofulous ulcerations*, but it is inferior in this respect to the sulphide. It has been prescribed in *mollities ossium*, *rickets*, and *dental caries* in children, and in all other conditions in which there would seem to be a lack of lime salts. Large doses are not advisable, on account of the liability to the formation of intestinal calculi. The earthy bodies obtained from bones, after the organic matters are dissolved out by a caustic alkali, are sometimes known under the name of "physiological calcium phosphate" and have been incorporated in bread, a method which is not to be commended, on account of the uncertainty as to the amount of the salt in a given quantity of bread. Its physical properties render it a desirable basis for powders, and it is employed in various pharmaceutical processes. A six-per-cent. solution of the salt, made with the aid of a little phosphoric acid, is sometimes used to wash out *tubercular tracts* and to saturate gauze that is to be used to pack *sinuses*, etc. It may be given in 10- to 30-grain doses. It is rarely used alone, but is generally combined with lactic acid to increase its solubility, the official syrup of the lactophosphate of calcium, *syrupus calcii lactophosphatis*, in 2- to 4-drachm doses, being the preparation most commonly employed.

Calcium sulphate.—See PLASTER OF PARIS.

Calcium sulphide.—This salt, CaS, rarely occurs in a pure state, but is generally combined with calcium sulphate and a small amount of carbon, which impurities should not exceed 40 per cent. It is sometimes made use of as a

depilatory, a layer of it being applied to the parts and after remaining about fifteen minutes being removed with a wet sponge or cloth. An impure solution obtained by boiling 1 part of sublimed sulphur, 2 parts of lime, and 10 parts of water is employed with success in the treatment of *scabies*, two or three coats of it being applied to the well-washed skin and allowed to remain until the water evaporates, thus leaving a thin layer of the salt. At the end of three or four hours this is washed off, and a cure usually results. It is much more cleanly than sulphur ointment and is just as effectual. Like the other sulphides, calcium sulphide has been used in baths in cases of *lead poisoning* and of *rheumatoid arthritis* when deformities of the joints exist, but is scarcely as desirable as the salts of potassium and sodium, on account of its slight solubility in water. It is hardly necessary to say that wooden or porcelain vessels are to be employed when it is used in this manner. There seems to be little question that all *suppurative processes* are modified by it in a most decided manner, ichorous pus being rendered laudable and *abscesses* hastened to maturation when once established or aborted if taken in time. *Carbuncles* and *furuncles* run a much shorter course, and their proneness to recur is overcome, under a persistent use of this salt. The various forms of *acne* and all *suppurative cutaneous disorders* are benefited by it, as well as the *abscesses* and *glandular enlargements* of strumous and scrofulous children. Without entering into a tedious recital of the various conditions in which it has proved of value, it is safe to say that there is scarcely any pathological suppurative process in which it will not probably prove advantageous, the other measures proper for building up the strength not being neglected. On the other hand, if its use is too long continued an anæmic condition will probably result. To children it may be given in $\frac{1}{20}$- to $\frac{1}{10}$-grain doses every two hours in cases where a speedy result is desired, or in $\frac{1}{6}$-grain doses three times a day in less acute conditions. For adults the dose may be as large as 1 grain three times a day, but less than this should be used at first and the quantity gradually increased. Aqueous solutions do not keep well, and if used must be freshly prepared every day. A convenient method for its administration is in the pill form. A substitute may be prepared by roasting and pulverizing eggshells, of which the dose may be 10 grains.—Russell H. Nevins.

CALENDULA (U. S. Ph.).—The florets of *Calendula officinalis*, marigold, were formerly put to various medicinal uses. The tincture, *tinctura calendulæ* (U. S. Ph.), is still supposed by some to have a beneficial effect when applied to *bruises*, *sprains*, etc.

CALISAYA.—See under Cinchona.

CALOLACTOSE.—A fanciful name for an alleged intestinal disinfectant said to consist of 1 part each of calomel and bismuth subnitrate and eight parts of sugar of milk.

CALOMEL.—See under Mercury.

CALOTROPIS.—The root of *Calotropis gigantea* and *Calotropis procera*, asclepiadaceous plants, is reputed tonic, diaphoretic, and "alterative." In large doses it is emetic. It has been used in the most diverse diseases, such as *leprosy*, *syphilis*, *epilepsy*, *rheumatism*, *intermittent fever*, *hectic fever*, and *dysentery*, and as a remedy against *snake-bites*. The acrid, milky juice has been employed as a *depilatory* and as an application in *toothache* due to caries. The dose of the powder is from 3 to 4 grains, twice a day.

CALUMBA (U. S. Ph.), **CALUMBÆ RADIX** (Br. Ph.), *columbo*, *radix columbo* (Ger. Ph.), is the root of *Jateorrhiza palmata*. It is an aromatic, bitter tonic. The dose of the powdered root is from 10 to 30 grains. The infusion, *infusum calumbæ* (Br. Ph.), may be given in doses of from 1 to 2 fl. oz. The dose of the tincture, *tinctura calumbæ* (U. S. Ph., Br. Ph.), is from $\frac{1}{2}$ to 2 fl. drachms; that of the solid extract, *extractum calumbæ* (Br. Ph.), is from 2 to 10 grains; that of the fluid extract, *extractum calumbæ fluidum* (U. S. Ph.), is from 10 to 30 drops.

CALX.—See Lime.

CAMBOGIA.—See Gamboge.

CAMOMILE.—See Chamomile.

CAMPHOID, a solution of 1 part of soluble gun-cotton and 20 parts of camphor in 20 parts of absolute alcohol, is used like collodion. It may be medicated with carbolic acid, iodine, iodoform, or resorcin, each of which it dissolves readily.

CAMPHOR, $C_{10}H_{16}O$, the *camphora* of the Ph's, is a concrete volatile oil, or stearoptene, that has the characteristics of a ketone, and is obtained by a steam distillation of the wood of *Cinnamomum* (or *Laurus*) *Camphora*, or *Camphora officinarum*. It may also be obtained synthetically by oxidation from borneol and camphene. The camphor laurel is an evergreen tree that is indigenous to China, Japan, and southeastern Asia, but grows in many tropical and subtropical countries. The branches, root, and trunk are chipped and boiled, or exposed to steam, and the camphor volatilizes. It is then condensed, the volatile oil is allowed to drain, and the camphor may be refined by sublimation.

There are many varieties of camphor. The camphor used in pharmacy is the product of the laurel tree, but refined by repeated sublimation. It was introduced into European medicine by the Arabians, who have left descriptions of its therapeutic properties.

If mixed with a little alcohol, ether, or chloroform, it can be pulverized. It is slightly soluble in water, more soluble in alcohol, and freely soluble in ether, chloroform, carbon disulphide, benzene, and fixed and volatile oils.

If it is triturated with chloral hydrate, carbolic acid, resorcin, thymol, or resins, the mixture becomes soft or liquid according to the proportion of the ingredients. For example, 1 part of camphor and 1 of chloral hydrate; 4 parts of camphor, 12 of carbolic acid, and 1 of water; 1 part each of camphor and thymol; 2 parts of camphor and 3 of menthol; 2 parts of camphor and 3 of salol; 2 parts of camphor

and 1 part of β-naphthol, will liquefy if triturated together. Camphor burns with a flame that gives off a great deal of carbon, and on this account is an excellent substance with which to smoke papers used to receive sphygmographic tracings.

Applied externally, camphor is a stimulant and rubefacient; on mucous membranes prolonged contact causes pain, tumefaction, and eventual ulceration.

Internally, it acts as a carminative in small doses, and as an irritant in large doses, causing nausea and vomiting. In moderate doses it stimulates the circulation in consequence of its action on the vaso-motor centre and cardiac muscle, a series of periodic rises of blood-pressure constantly taking place. The stimulation is of short duration and is not followed by exhaustion or depression. But in large doses, from 20 to 60 grains, camphor exercises a powerful sedative influence on the nervous and vascular systems, and this is followed by ataxic phenomena. In animals the power of co-ordination becomes so much impaired that it is impossible to rise, the cutaneous vessels are dilated, respiration is slowed, there is stupor, then tremor that develops into clonic convulsions involving all the muscles; the convulsions may be stopped by chloroform. Consciousness becomes abolished, sensation is impaired, and the animal lies on its side trembling continuously and having true epileptic convulsions at intervals. Professor Stockman found that the foregoing symptoms might persist for forty-eight hours, the heart continuing to beat regularly, the temperature falling, and death finally resulting from paralysis of respiration.

Toxic doses in man cause giddiness, mental confusion, and convulsions, sometimes with insensibility, coma, and death. There are faintness, nausea, vomiting, and gastro-intestinal inflammation. The heart is depressed, arterial tension is lowered, the skin is cold, and the spinal reflexes are diminished. Where camphor poisoning has occurred, emetics should be administered, caffeine and strychnine should be injected hypodermically, and chloroform or opium be used to control the convulsions.

In moderate doses camphor lowers the excitability of the spinal cord, and is an antispasmodic and sedative, allaying abnormal nervous excitability by increasing the inhibitory power of the higher over the lower brain centres. It is a stimulant expectorant; it strengthens the respiration and circulation, and increases the arterial tension.

It excites the brain and the medulla oblongata, producing a rapid succession of ideas, restlessness, agreeable hallucinations, and laughing. It is a diaphoretic and a feeble antaphrodisiac. In solution (1 to 2,500) it inhibits the growth of micro-organisms.

Camphor is a diffusible stimulant, its effects appearing rapidly and quickly disappearing. This action is best produced by administering it in small, frequently repeated doses; but if its sedative effect is desired it should be given in larger doses at longer intervals.

Camphor was formerly used considerably as an application to *atonic* and *fungous ulcers*, and in *hospital* or *idiopathic gangrene*. The powder, an ointment, or the spirit was applied to the ulcer, and the germicidal properties of the drug as well as the stimulating effect of its local application were undoubtedly beneficial. In recent years camphor has been employed in this way in conjunction with some more powerful antiseptic. "Carbolate of camphor," or camphorated carbolic acid, prepared by triturating 12 parts of pure carbolic acid with 4 parts of camphor and 1 part of water, has proved an efficient antiseptic and germicide and a useful application in *erysipelas*, and its anæsthetic effects have been made use of in *endometritis* and *uterine endotrachelitis*. Camphorated naphthol is made by mixing 1 part of β-naphthol with 2 parts of camphor. It is a powerful antiseptic. Camphorated salol, made by combining 3 parts of salol with 2 of camphor, has been effectively used instead of iodoform. Salicylated camphor, prepared by heating together 84 parts of camphor and 65 of salicylic acid, has been found a useful application in *lupus* and *rodent ulcer*.

For *sprains* and *enlarged joints* the topical application of camphor, on account of its refrigerating influence due to volatilization and its stimulating effect on the capillaries, is quite useful. Applied as an ointment, a liniment, or a fomentation, camphor helps to resolve *swellings* and *extravasations from bruises*. Spirit of camphor may be applied to the skin to prevent *bedsores*.

Trousseau applied camphorated ether to the affected regions in certain *cerebral affections* and in *peritonitis* for its refrigerant effect.

In *mastitis* and *galactorrhœa* camphorated oil, liniment, or cerate is indicated. The frequent application of the strong spirit of camphor is recommended for *boils*. In *pruritus pudendi*, *pruritus ani*, *eczema*, and *intertrigo* it allays the heat, the tingling, and the itching; it may be applied in a powder, mixed with starch, or as an ointment. For *vaginismus* and *urethral*, *vesical*, and *rectal spasm* Jeannel recommended the employment of suppositories composed of 1 part each of powdered camphor and white wax and 25 parts of cacao butter. For *myalgia* applications of the liniment, spirit, or vinegar of camphor may be made; or the camphor may be combined with equal parts of chloral hydrate. This latter combination is more useful than camphor alone in the treatment of *odontalgia*. Camphor water or the spirit of camphor is very useful as an antiseptic mouth wash or to relieve foulness of the breath; a formula for camphor tooth-powder is given below.

In *coryza* in which there are incessant sneezing, profuse discharge, and nasal irritation, finely powdered camphor may be inhaled, or some of the spirit may be poured on boiling water and the steam inhaled through a metallic or paper cone, or a douche of camphor water may be employed. An attack of coryza may often be aborted by 10-drop doses of the tincture taken every fifteen minutes. In *adynamic fevers* the stimulating and antiseptic effects of camphor have been commended; it

may be administered in camphor wine, camphor spirit, or oil

In *colic*, *gastralgia*, *cholera*, *cholerine*, and *hysterical vomiting* the rapid stimulation produced by camphor will be found useful.

In *influenza*, *bronchitis*, *pharyngo-laryngitis*, *pneumonia*, and *broncho-pneumonia* 30 to 60 minims of a solution of camphor in sweet-almond oil, from 1 to 5 per cent., increase arterial pressure and expectoration, and improve the patient's feelings.

The hectic fever, the sweats, and the cough of *tuberculosis* have been relieved by 15-minim injections of camphorated oil. After from eight to ten days' use the oil sometimes caused headache and insomnia.

As an antispasmodic and sedative, camphor has been administered in *restlessness*, *nervousness*, *delirium tremens*, *insanity*, *angina pectoris*, *chorea*, and *migraine*.

Dewees considered camphor a certain and uniform sedative in *dysmenorrhœa*. Lombard has reported that it relieved *palpitation*.

The value of camphor in the treatment of the various forms of *sexual excitement* is disputed. Large doses are said to be antaphrodisiac. It is likely to be of more value when given as a monobromate.

Oil of camphor is the volatile oil obtained in the production of camphor. It is a red or yellowish-brown liquid that has the odour and taste of camphor. It is said to be more stimulating than camphor, and has been administered in *cholera morbus* and *colic* in doses of from 5 to 10 drops. It has also been applied locally.

Camphoric acid (*acidum camphoricum*) is formed by the oxidation of camphor with nitric acid by means of prolonged boiling. It occurs as a white crystalline powder, slightly soluble in water, having a faint aromatic odour and a somewhat saline and camphor-like taste. It may be administered in aqueous or alcoholic solution or in glycerin.

Hartleib has stated that it has a definite action on the *night sweats of phthisis*, which are arrested or diminished by doses of from 15 to 30 grains three times a day. It acts better if the tuberculous process is not complicated by a suppuration. Irrigation of the bladder twice daily with a ½-per-cent. solution is said to have cured *cystitis* in from three to six weeks. Given internally, in doses of from 7 to 15 grains three times a day, it has cured *gonorrhœa*.

By the action of bromine in certain proportions on camphor a substitution compound, *monobromated camphor*, $C_{10}H_{15}BrO$, *camphora monobromata* (U. S. Ph.), is obtained. This substance occurs in white prismatic needles or scales that have the odour and taste of camphor; they are permanent in the air, unaffected by light, and neutral in reaction. This substance is almost insoluble in water, but is freely soluble in alcohol, in chloroform, in hot benzene, in ether, and in fixed and volatile oils. Monobromate of camphor combines the action of bromides and camphor; it lowers the circulation, respiration, and temperature. It is used as a hypnotic and sedative in conditions of *nervous excitement*, especially of the sexual centres, in *petit mal*, in *hysteria*, in *chorea*, and in *delirium tremens*. As it is comparatively insoluble, it should be administered in pills or capsules. The dose is from 2 to 10 grains. An unofficial elixir of monobromate of camphor is in use in England; it consists of 20 grains of monobromated camphor dissolved in 15 fl. drachms of spirit of cinnamon and added to 20 fl. drachms of red elixir and 5 fl. oz. of syrup. Each ounce contains 4 grains.

Spirit of camphor, *spiritus camphoræ* (U. S. Ph., Br. Ph.), *alcool camphoratus* (Fr. Cod.), is a solution of 1 part of camphor in 9 parts of alcohol. The German *spiritus camphoratus* is of the same strength, but the 1 part of camphor is first dissolved in 7 parts of alcohol, and then 2 parts of water are added. The dose is from 5 to 30 minims. A feebler tincture is official in France as *alcool camphoratus debilior*. It is a solution of 1 part of camphor in 39 parts of alcohol. Compound tincture of camphor, *tinctura camphoræ composita* (Br. Ph.), is paregoric (see under Opium). The Fr. Cod. prescribes an ethereal tincture, *tinctura ætherea camphorata*, made by dissolving 1 part of camphor in 9 parts of ether. It is applied externally as a refrigerant.

Camphorated wine, *vinum camphoratum* (Ger. Ph.), is a turbid, whitish liquid, made by adding 1 part of camphor dissolved in its own weight of alcohol to a mixture of 3 parts of mucilage of acacia and 45 of white wine. It should be shaken before being dispensed.

Camphorated vinegar, *acetum camphoratum* (Fr. Cod.), is composed of 25 parts each of camphor and crystallized acetic acid and 950 of white vinegar. It is used as an external application.

Camphor water, *aqua camphoræ*, according to the U. S. Ph., is made by triturating 8 grammes of camphor with 5 c. c. of alcohol and 5 grammes of precipitated calcium phosphate and adding enough distilled water to make 1,000 c. c. The British preparation is a solution of variable strength (thought to be less than 1 to 1,000) made by subjecting 1 part of camphor in a bag to the action of 256 parts of distilled water. The dose of the U. S. preparation is from a teaspoonful to two tablespoonfuls.

The camphor liniment, *linimentum camphoræ*, of the U. S. Ph. is a solution of 1 part (by weight) of camphor in 4 parts of cottonseed oil; that of the Br. Ph. is a solution of 1 part of camphor in 4 fl. parts of olive oil. The *oleum camphoratum* of the Ger. Ph. is a filtered solution of 1 part of camphor in 9 parts of olive oil. The *linimentum camphoræ compositum* of the Br. Ph. consists of 2½ oz. of camphor, 1 fl. drachm of oil of lavender, 5 fl. oz. of strong solution of ammonia, and 15 fl. oz. of rectified spirit. The *linimentum ammoniato-camphoratum* of the Ger. Ph. is made of 3 parts of camphorated oil and 1 part each of poppy oil and ammonia water.

Camphor cerate, *ceratum camphoræ* (U. S. Ph.), is made of 1 part of camphor liniment, 3 parts of white wax, and 6 parts of lard.

Camphor ball, an unofficial preparation used in Great Britain for *chapped skin*, is prepared by melting together over a water-bath 4 parts

of spermaceti, 12 of white wax, and 5 of oil of almonds. In this mixture 4 parts of flowers of camphor are dissolved, and when the mass is nearly cold it is poured into boxes or moulds.

Camphorated chalk is another unofficial British preparation that is used as a dentifrice. It is made by mixing in a mortar 1 part of flowers of camphor and 7 parts of precipitated calcium carbonate, to which a few drops of rectified spirit are added, and the powder is then sifted.

Camphor elixir is an unofficial English preparation composed of a mixture of 10 drachms of spirit of camphor, 5 drachms of syrup, and 1 drachm of distilled water. Each drachm contains 4 grains of camphor. It is used as a carminative and mild stimulant in doses of from ½ to 1 drachm.—SAMUEL T. ARMSTRONG.

CAMPHORIC ACID.—See under CAMPHOR.

CANELLA, *canellæ cortex* (Br. Ph.), is the bark of *canella alba.* It has been dismissed from the U. S. Ph., and is not in general use in the United States. Bartholow, however, is inclined to consider it of more value than is generally thought, and gives to it some little consideration.

The therapeutic activity of canella depends upon a bitter principle and a volatile oil. A resin, too, is present. The possession of these ingredients places canella in the class of aromatic bitters, with such drugs as serpentaria, absinthium, cascarilla, and prunus virginiana.

The chief therapeutic application of canella is as an aromatic bitter and stomachic in conditions of *digestive atony*, especially *flatulent dyspepsia*, or in *convalescence*, where it may be of much service. For this purpose a tincture was formerly in use which contained 1 part of canella alba and 8 parts of alcohol. To this preparation was given the name *tinctura canellæ albæ.*

In addition to the qualities already described, Bartholow calls attention to the value of canella in certain pelvic conditions and refers to the experience with it had by Dr. Cheron, who extols it as a remedy for the *menorrhagia* and *metrorrhagia* of *chlorosis*, for the *menorrhagia occurring during pregnancy* in weak, lymphatic women, for the *menorrhagia of cancer*, and for "*persistent bleeding after delivery*, due to the inefficient involution of the uterus in some weak subjects." The drug is also recommended in *congestive dysmenorrhœa*, in combination with aloes, if constipation is present.

In spite of these recommendations, however, canella remains almost unused by the profession, and, indeed, the little use it has is almost invariably in combination with other drugs and mainly for its stomachic value and for its power as an adjuvant to purgatives, especially aloes.—HENRY A. GRIFFIN.

CANNABINE is an alkaloid extracted from *Cannabis indica.* The tannate has been used as a hypnotic in doses of from ⅘ to 1½ grain.

CANNABIS INDICA, *Cannabis sativa*, Indian hemp, the *hasheesh* of the Arabians, is the ordinary hemp plant, indigenous to Asia and northern Africa, but cultivated in the United States and Europe. That which comes from India is most active in its effects, though Professor H. C. Wood says that some which was cultivated in Kentucky, where the warm summers approach the torridity of Hindustan, yielded an extract of considerable power. The tops with the flowers are the parts used, the female plants being selected at about the time of the ripening of the seed. *Cannabis americana* is the same plant when cultivated in America.

The physiological effects of the Indian hemp vary to a most extraordinary degree. This is thought by some to be due to the fact that the different extracts are of unequal strength, some of them being entirely inert. But there is good reason to believe that with the same extract decidedly different effects, both in kind and in degree, are produced upon different individuals, so that the practitioner, if he intends to use it at all, should not only test different extracts until he finds one that is active, and the proximate activity of which he knows, but also, in the treatment of an individua patient, should begin with a moderate dose and slowly increase or diminish it according to the results obtained. It is thought that during the transportation of the plant tops from India to this country their efficacy is in some way lost, probably through long exposure to the moist ocean air. However this may be, there can be no doubt that the extracts made in England and in Europe generally are superior to those made in this country.

The first sensations experienced after having taken a moderate dose of cannabis indica are a feeling of exhilaration and general well-being. If the dose is large enough, this is soon followed by a merry and somewhat boisterous state of mind, with expansive ideas and a marked increase of the *amour propre.* According, probably, to the temperament of the person, there may or may not be an excitation of the aphrodisiac impulse. but, as has been noted particularly by the British medical officers, there is always increased hunger. When the effect is still more pronounced, in consequence either of a larger dose having been administered or of greater susceptibility on the part of the patient, there is, according to his temperament, either an increase of pseudo-maniacal excitement, with hallucinations, leading sometimes, among the Orientals, to the dangerous symptom of "running amuck," or, as is more commonly the case among the Caucasians, to the most frightful sensation of impending dissolution. This condition the writer has seen accompanied by a decided cyanosis in one case, approaching in intensity that which occurs during nitrous-oxide anæsthesia. The subjective symptoms undergo also a rhythmic variation, increasing and diminishing at short intervals. The sense co-ordinations, too, are interfered with, and the senses of time and space greatly exaggerated. The succession of ideas during the periods of activity is so rapid as to prolong, subjectively, minutes into hours or days. There is also marked anæsthesia of the sensory nerves,

with a feeling of excessive weight in the limbs, which is apparently due to disturbance of the muscular sense. The reflexes being slow or at times almost abolished may partly account for the rush of ideas, the brain occupying itself with the re-representation (recollection) of former impressions. In addition to the above-mentioned symptoms there are increased cardiac and respiratory activity, a tendency more or less distinct to greater freedom of the intestinal vermicular motions, and an undoubted diuretic effect. No fatal case of poisoning has been recorded.

It will be seen from the foregoing account of its physiological action that the range of therapeutical application of Indian hemp is quite limited. Indeed, owing to the uncertainty of its effects and the occasional supervention of exceedingly distressing if not alarming symptoms, cannabis indica is not, and probably never will be, a popular remedy among European and American physicians.

The soothing mental effects of small doses are, however, of use in combating the *insomnia* of brain workers or of those who are depressed by care and anxiety. By lulling the senses and diminishing the sensibility to external impressions, it, in the happy phrase of Dr. Clendenning,* "conciliates sleep"—that is, puts the patient into a condition favourable for sleep. It is also of some use in *neuralgic affections*, and from its marked effect on the peripheral nerves of the lower extremities would probably be especially applicable in *sciatica*; and other peripheral neuralgias might be expected to yield to it, at least temporarily. So they do, and it would be one of our most valuable aids in the treatment of neuralgias were it not for the uncertainty of its action.

Its power of benumbing the sensory apparatus, and so diminishing the peripheral reflexes, render it a useful antispasmodic in *hay asthma*, *epilepsy*, *dysmenorrhœa*, some forms of *cough*, *asthma* of the spasmodic variety, and, above all, *tetanus*. It has been recommended by some authors for the relief of the pains of *chronic rheumatism*, but has been superseded by more reliable agents. For the milder uses detailed above, the dose of the extract is from ¼ to ½ a grain, or from 15 to 20 minims of the tincture, though it might be well to begin with less in order to provide against any idiosyncrasy on the part of the patient. This dose is administered two, three, or four times a day; and the safer and more efficacious method of its exhibition would undoubtedly be to give small quantities frequently.

In *tetanus*, however, the dose should be as much as ½ a grain of the extract, or 40 minims of the tincture, every two or three hours. Here, in order to obtain the best results, it must be combined with other antispasmodics—viz., bromides, atropine, chloral, opiates, etc. It would appear from the pathology, the clinical history, and the accounts of the treatment of cases of this terrible disease, that a judicious combination of remedies promises far more than reliance upon any one drug, no matter what its published indorsements may be.

Finally, I would say that, in general practice, there are but three indications for the use of cannabis that seem to me to merit the serious attention of the physician—viz., *insomnia* from overwork or great depression, characterized by restlessness and jactitation; second, *constipation*; third, extreme and obstinate *anorexia*. In all of these, careful combination with other drugs will greatly assist in its use, and enable us to get along with smaller doses than if we used the Indian hemp alone. As for its employment in the treatment of dropsies and neuralgias, we may say that there are other remedies that are more deserving of trial, that are safer, and that should first be tested before resorting to this uncertain one. But it may be combined with the others in suitable cases, and sometimes with profit.

[The *extractum cannabis indicæ* of the U. S. Ph. and that of the Br. Ph., though made by somewhat different processes, do not seem to differ materially. The dose of the British preparation is set down as from ¼ to 1 grain. The *tinctura cannabis indicæ* of the U. S. Ph. is made by maceration and percolation from 150 grammes of the powdered cannabis and enough alcohol to make 1,000 c. c.; the British tincture is a simple solution of 1 oz. of the extract in 1 pint of rectified spirit, and the dose is from 5 to 20 minims. The *extractum cannabis indicæ fluidum* of the U. S. Ph. is prepared by percolation, evaporation to the consistence of an extract, and subsequent addition of alcohol, using 1,000 grammes of cannabis and enough alcohol to make 1,000 c. c. The dose of the fluid extract is from ½ to 1 minim.]—BENJAMIN F. WESTBROOK.

CANTHARIDATES.—See under CANTHARIDIC ACID.

CANTHARIDES, Spanish flies, are the dried bodies of *Cantharis vesicatoria*, a coleopterous insect very common in southern Europe. They depend for their action upon the presence of a white crystalline body, cantharidin, $C_{10}H_{12}O_4$, which by the addition of water is converted into cantharidinic acid, $C_{16}H_{14}O_5$, which combines with some of the bases to form cantharidinates. A large number of species of cantharis and other coleopterous insects are substituted in various parts of the world for the official variety with perfectly good results, and little beyond custom has prevented their universal adoption into medicine. Externally, the effects of this drug are rubefacient and vesicant, and internally irritant, with a marked predilection for the genito-urinary tract, which effect is also observed after its external use in sufficiently large quantity or for too long a time. The effects of poisonous doses are irritation and inflammation of all parts of the alimentary canal with which the drug comes in contact, abdominal pain, bloody stools, salivation, extreme thirst, disturbances of the pulse and respiration, elevation of the temperature followed later on by depression, bloody urine, strangury, and priapism. After the ingestion of smaller but unduly large doses the genito-

* Quoted by Dr. Waring. *Practical Therapeutics*, second American edition, 1871.

urinary irritation is the most marked symptom. The smallest fatal dose on record is about 24 grains. Post-mortem examinations in fatal cases reveal inflammation of the entire alimentary canal, congestion of the genito-urinary tract, and the presence of cantharidin, which, it is said, can be separated from the intestines several months after death and interment. The treatment in cases of poisoning by this substance must be conducted upon general principles. The stomach and intestines are to be emptied by emetics and cathartics, large amounts of diluent drinks should be given, and the pain is to be relieved with opium and camphor.

Observation of the priapism excited by excessive doses has given cantharides the reputation of being a powerful aphrodisiac, and it has been repeatedly administered for this purpose with criminal intent and with the most unfortunate results. In cases of impotence, in which the loss of sexual power appears to be dependent upon decreased vascularity and lack of tone of the genital organs small doses, especially when combined with iron, are of use, but anything beyond this is unsafe. Large doses affect the kidneys unfavourably. As an abortifacient it is of no value, as almost lethal doses are necessary for such a purpose. For vesicating purposes it is more extensively employed than any other substance, and for details the reader is referred to the article on BLISTERS. All *chronic affections of the bladder* and *urethra*, such as *chronic cystitis*, *gleet*, *prostatorrhœa*, and *spermatorrhœa*, provided there are no active inflammatory processes present, are often marvellously benefited by small doses; *amenorrhœa*, *irritability of the bladder in women* in which there is an escape of a few drops of urine after micturition, and *menorrhagia* caused by a lack of vascular tone, may be relieved by it, but, unfortunately, there are no indications to enable one to distinguish the appropriate cases. It should hardly be necessary to observe that when it is employed for any length of time the urine must be examined frequently for albumin, the presence of which calls for the instant discontinuance of its employment, and it is also wise to insist upon the drinking of large amounts of fluids, as this seems to prevent to some extent its irritating effects upon the kidneys. *Dysuria* and *irritability of the bladder in old men* are conditions in which it is often used with good results, especially when combined with strychnine.

The progress of *diabetes insipidus* seems to have been modified by the drug in some instances, but not much dependence can be placed on it. *Chronic desquamative nephritis*, especially when albuminuria is brought on by slight exertion, may be benefited by 4- or 5-drop doses of the tincture three times a day, provided there is no increase in the albumin in the urine during the administration of the drug. There seem to be some grounds for believing that *tubercular processes* are somewhat modified by it, the theory being that it causes an effusion of serum at the diseased points which has a fatal effect upon the tubercle bacilli. Whether there are any grounds for this assumption or not, good results are reported to have followed hypodermic injections of $\frac{1}{500}$ of a grain of potassium cantharidinate.

The *fissures of eczema* are often rendered less painful and sometimes cured by painting them with the tincture, and a mixture of 1 part of it and 40 of water relieves the pain of *small superficial burns*. As regards *alopecia*, nearly all "hair tonics" contain more or less cantharides in one form or another, but their virtues are not particularly increased by it.

The powder may be given in 1- to 2-grain doses, in pill form, but the tincture is the most desirable preparation in which to use it. The *tinctura cantharidis* of the U. S. Ph. may be given in from 3- to 10-drop doses, that of the Br. Ph. in double those quantities, and the *tinctura cantharidum* (Ger. Ph.) in from 2- to 5-drop doses.

[Vinegar of cantharides, *acetum cantharidis* (Br. Ph.), is made with 1 part of bruised cantharides, 1 fl. part of glacial acetic acid, and 10 fl. parts of ordinary acetic acid. It is used as a rubefacient. Cantharidal cerate, *ceratum cantharidis* (U. S. Ph.), is made from 32 per cent. of cantharides and 15 per cent. of oil of turpentine, the remainder being yellow wax, resin, and lard. The *unguentum cantharidis* of the Br. Ph. is much milder, being made from 1 part each of cantharides and yellow wax and 6 fl. parts of olive oil. The *unguentum cantharidum* of the Ger. Ph. is stronger than the U. S. preparation, being made of 3 parts of cantharides and 2 of yellow wax. The *oleum cantharidatum* of the Ger. Ph. is of about the same strength as the U. S. cantharidal cerate; it is an infusion of 3 parts of cantharides in 10 of olive oil. Blistering plaster, *emplastrum cantharidis* (Br. Ph.), contains 40 per cent. of cantharides; the *emplastrum cantharidum ordinarium* (Ger. Ph.), 25 per cent.; the *emplastrum cantharidum perpetuum* (Ger. Ph.), 10 per cent.; and the *emplastrum cantharidum pro usu veterinario* (Ger. Ph.), 3 parts of cantharides, 1 part of euphorbium, and 6 parts each of colophony and turpentine. The *emplastrum calefaciens* of the Br. Ph. contains the active principle of 1 part of cantharides in about 24 parts of the plaster. Cantharidal collodion, *collodium cantharidatum* (U. S. Ph.), is made by exhausting 60 parts of cantharides with chloroform, recovering the chloroform by distillation, evaporating the residue to 15 parts, and dissolving it in 85 parts of flexible collodion. The *collodium vesicans* of the Br. Ph. is a solution of 1 part of pyroxylin in 20 fl. parts of the *liquor epispasticus* (Br. Ph.), which is made by exhausting 5 parts of powdered cantharides and percolating until the product measures 20 fl. parts. Blistering paper, *charta epispastica* (Br. Ph.), is paper coated on one side with a plaster into the composition of which enters the material extracted from $\frac{1}{5}$ of its weight of cantharides.]

RUSSELL H. NEVINS.

CANTHARIDIC ACID, $C_{10}H_{12}O_4 + H_2O$, seems to be a compound of cantharidin and water. It forms salts, termed *cantharidates*, some of which have been employed in the treatment of *pulmonary tuberculosis*, on the

theory mentioned in the article on CANTHARIDES. *Potassium cantharidate* has been used especially to allay the cough of the early stage of the disease. It is administered hypodermically, beginning with 0·015 of a grain as a dose, and increasing gradually to twice that amount, but not giving more than one injection in the course of twenty-four hours. *Cocaine cantharidate*, prepared by mixing sodium cantharidate with 1 per cent. of cocaine hydrochloride, can, it is said, be injected subcutaneously without giving rise to the pain caused by the similar employment of other cantharidates. The usual dose is about $\frac{1}{100}$ of a grain, but much larger doses have been given. The cantharidates require to be used with great caution, and their employment is contra-indicated by any irritated state of the kidneys or of the digestive tract.

CANTHARIDIN.—The active principle, $C_5H_6O_2$, of cantharides (see under CANTHARIDIC ACID).

CANTHARIS.—See CANTHARIDES.

CAPSICUM (U. S. Ph.), *capsici fructus* (Br. Ph.), *fructus capsici* (Ger. Ph.).—The dried ripe fruit of several varieties of the genus *Capsicum*, reduced to a powder constituting Cayenne or red pepper. When applied to the skin or a mucous membrane, any of the preparations of this drug causes a greater or less degree of irritation, and if the contact is sufficiently prolonged vesication will ensue. Internally, it gives rise to a sense of warmth in the stomach and stimulates the secretion of the saliva and gastric juice, and thus aids digestion, excites the peristaltic action of the intestines, and is a stimulant to the genito-urinary tract. In excessive doses it irritates the alimentary canal, and if its use as a condiment is carried too far tolerance is established and permanent torpor of the digestion set up. It is a feeble cardiac stimulant and assists the action of diaphoretics. It is chiefly excreted by the kidneys. The common black pepper has practically the same effects as the red, but in a much less-marked degree. When a moderate amount of counter-irritation is desired one or another of the preparations of this drug is very eligible, as there is little probability that a blister will ensue. For this purpose a capsicum plaster is the most elegant and convenient form which can be used. An equally effectual plaster or paper can be made by mixing the tincture with gum arabic and painting tissue paper with it. This paper, applied over *painful joints* or the seat of *neuralgia, lumbago*, etc., will often relieve the pain, also that and the itching of *chilblains*. In this latter condition capsicum must not be used when the skin is broken. What is known as a spice bag forms a useful application where a mild degree of counter-irritation over a considerable surface is desired. This consists of 2 tablespoonfuls each of ground allspice, cinnamon, cloves, and ginger, and ½ pint of red pepper thoroughly mixed and put into a flat bag. Before using it it is dipped in vinegar or spirit. Lint soaked in a strong infusion of the pods and covered with rubber or oiled silk is used with a good deal of success in relieving the pain of *rheumatism, lumbago, sciatica, stiff-neck*, etc.

For the restlessness and insomnia of *delirium tremens* there is probably no remedy which is so safe and so efficient as capsicum. In such cases the initial dose should be from 20 to 30 grains mixed with honey or syrup or combined with soup or beef tea and followed in three hours by 15 grains more if the first dose has failed to produce sleep. It is also advisable to combine a liberal amount with the food of these patients as soon as they can be induced to take any. During the stage of extreme restlessness which follows after the abrupt shutting off of alcohol or opium, in those addicted to their use, 10-drop doses of the tincture, combined with lemonade if there is any resistance to its use, every three or four hours is of great benefit, and a bromide may be added if it seems desirable. Given in this way, capsicum seems to remove to some extent the craving of *dipsomaniacs* for alcohol. It also will "straighten out" a person recovering from a debauch and is especially indicated in the *dyspepsia of hard drinkers*. *Atonic dyspepsia* is sometimes benefited by its use, but it should not be given for too long a period, as tolerance is soon established. Ten grains of the powder combined with an equal amount of quinine adds very materially to the effect of the latter in the treatment of *intermittent fever*. Capsicum may be used in *flatulent colic*, but is not so effective as turpentine or asafœtida as a carminative. An infusion of 2 drachms in a pint of hot water makes an admirable gargle for *amygdalitis* and the *sore throat of scarlet fever*, except when the inflammatory processes are very active, when it will probably do more harm than good. Mild cases of *diphtheria* are very satisfactorily treated with this infusion. The diluted tincture is sometimes used as a stimulating application to *unhealthy ulcers* or *suppurating surfaces*; 5- to 10-drop doses of the tincture are useful in the late stages of *sea-sickness* when the person begins to crave food. Grain doses of the oleo-resin, combined with ergotin or erythroxylon, three times daily, have decided aphrodisiac effects. In the *chronic affections of the genito-urinary tract* where a slight stimulating effect is sought for it has been used with benefit (cf. CANTHARIDES). *Hæmorrhoids* are sometimes relieved, both by this variety and by the common black pepper. The tincture has been used in cases of *collapse*, and forms an ingredient of nearly all varieties of cholera and diarrhœa mixtures. Commercial red pepper has been sophisticated by the addition of a number of bodies to increase its weight, none of which are deleterious except red lead and vermilion, which in a number of instances have given rise to chronic lead and . . curial poisoning. Incinerating the pepper at a low red heat will reveal the presence of a mineral adulterant, and the exact nature of it can be determined by the application of the usual tests (cf. LEAD and MERCURY). The tincture is added to many stimulating liniments and dentifrices. The powder is sometimes incorporated in plasters used for counter-irritation.

[The *tinctura capsici* of the U. S. and Br. Ph's may be given in doses of from 10 to 20

minims, in a mucilaginous vehicle; that of the Ger. Ph. in half those doses. The dose of the *extractum capsici fluidum* of the U. S. Ph. is the same as that of the powder. The oleoresin, *oleoresina capsici* (U. S. Ph.), contains all the virtues of capsicum, and may be given in doses of from ¼ to 1 minim. It is spread on resin plaster to form the *emplastrum capsici* of the U. S. Ph., which is used as a rubefacient.]

RUSSELL H. NEVINS.

CARAWAY.—See CARUM.

CARBOLIC ACID, *acidum carbolicum, phenol, phenic acid, phenyl hydrate, phenylic alcohol*, C_6H_5OH, is a derivative of coal tar obtained by fractional distillation. A subsequent purification results in a pure carbolic acid, which alone is recognised under the name carbolic acid by the pharmacopœias, the unpurified form, however, being official in the U. S. Ph. under the name of *acidum carbolicum crudum*, crude carbolic acid. The pure acid appears as "colourless interlaced or separate needle-shaped crystals, or a white, crystalline mass, sometimes acquiring a reddish tint: having a characteristic, somewhat aromatic odour, and, when copiously diluted with water, a sweetish taste, with a slightly burning after-taste. Deliquescent on exposure to damp air. Soluble at 15° C. (59° F.), in about 15 parts of water, the solubility varying according to the degree of hydration of the acid" (U. S. Ph.). It is also soluble in alcohol, in ether, in glycerin, and in the fixed and volatile oils. Subjected to gentle heat it melts, and is liquefied also (not dissolved) by the addition of about 8 per cent. of water. Carbolic acid should be kept in dark amber-coloured, well-stoppered bottles. The dose for internal administration is from 1 to 3 grains.

Liquefied carbolic acid, *acidum carbolicum liquefactum* (Br. Ph., Ger. Ph.), is carbolic acid liquefied by the addition to it of 10 per cent. of water. On account of the difficulties attending the manipulation of carbolic acid in the solid state, it is generally liquefied when used by the addition of water or of glycerin, and the term "liquefied carbolic acid" is used simply in recognition of this general practice, and this form of the drug is designed for convenience in dispensing. The dose of it is from 1 to 4 minims. Carbolic-acid water, the *aqua carbolisata* of the Ger. Ph., is a 3-per-cent. solution of this liquefied carbolic acid in water.

Glycerite of carbolic acid, *glyceritum acidi carbolici* (U. S. Ph.), or glycerine of carbolic acid, *glycerinum acidi carbolici* (Br. Ph.), is a solution of carbolic acid in glycerin. The strength of the former preparation is 1 part in 5, that of the latter 1 part in 6 by weight.

The ointment of carbolic acid (*unguentum acidi carbolici*) of the U. S. Ph. contains 5 parts of carbolic acid and 95 of simple ointment; that of the Br. Ph. contains 1 part of carbolic acid, 12 parts of soft paraffin, and 6 parts of hard paraffin.

Suppositories of carbolic acid (*suppositoria acidi carbolici cum sapone*) are official in the Br. Ph. Each suppository contains 1 grain of the acid.

Crude carbolic acid, *acidum carbolicum crudum* (U. S. Ph.), also known as impure carbolic acid, consists of various constituents of coal tar, chiefly cresol and phenol, and is obtained by fractional distillation. It appears as "a nearly colourless, or reddish, or brownish-red liquid, of a strongly empyreumatic and creosote-like odour; having a benumbing, blanching, and caustic effect upon the skin or mucous membrane, and gradually turning darker on exposure to air and light" (U. S. Ph.). The sole use of this preparation is as a disinfectant of such articles as drains, closets, floors, and coarse clothing; to the very moderate disinfectant action of carbolic acid the "impurities," cresylic acid (cresol) and xylic acid, add their own very considerable powers as disinfectants.

The many valuable qualities possessed by carbolic acid account for its having been made an ingredient of a vast number of unofficial preparations, of which some few are in sufficiently general use and of great enough value to make their presentation here desirable. Among these is carbolised oil, *oleum carbolatum* (Nat. Form.), a 5-per-cent. solution of carbolic acid in cotton-seed oil. The special application of this preparation is in genito-urinary surgery. A similar preparation, called Lund's oil, is considerably employed in England as a lubricating application for catheters. It is composed of 1 oz. each of olive oil and castor oil and 1 drachm of carbolic acid. Iodised phenol, *acidum carbolicum iodatum* (Nat. Form.), is another of these preparations. It contains 20 parts of powdered iodine, 76 of carbolic acid, and 4 of glycerin. It is employed as a stimulant and antiseptic application. Of similar composition is Boulton's solution, *liquor iodi carbolatus* (Nat. Form.). Carbolised gauze, *carbasus carbolata* (Nat. Form.), is one of these unofficial though frequently used preparations. To make it, 40 parts of coarsely powdered resin, 5 of castor oil, and 10 of carbolic acid are dissolved in 225 of alcohol. In this a sufficient quantity of gauze is soaked. Upon its removal from the liquid it is pressed until the weight of the wet gauze amounts to 170 for every 100 of the original cloth. The medicated gauze is then kept spread out until the alcohol is nearly evaporated, when it is wrapped in paraffin paper and placed in air-tight vessels. The celebrated Dobell's solution, *liquor sodii boratis compositus* (Nat. Form.), certainly owes some of its efficiency to carbolic acid. It contains 120 grains each of sodium borate and sodium bicarbonate, 24 grains of crystallized carbolic acid, ½ fl. oz. of glycerin, and enough water to make 16 fl. oz. It is much used as a cleansing spray for the nose and throat.

Though most of the pharmacopœias recognise only the pure acid, and the U. S. Ph. describes no forms between the pure and the crude acid, in commerce carbolic acid appears in five degrees of purity, graded numerically. Of these, number one is the purest and alone is fitted for internal administration, though both number one and number two are crystalline. Number three, number four, and number five are "impure" because of the presence of other ingredients of coal tar, especially cresol, and

are adapted to the uses already described in speaking of crude carbolic acid. Of aqueous solutions of pure carbolic acid it is characteristic that they remain colourless, while the presence of impurities produces in such solutions a brown discoloration upon exposure.

The odour of carbolic acid is so characteristic that it alone will often be a sufficiently delicate test of the acid's presence. Of chemical tests there are many, but one of the greatest delicacy is offered by the addition of bromine water in excess to the fluid to be tested. Should carbolic acid be present in the slightest amount (it is said that a solution containing but 1 part to 60,000 will answer to the test within twenty-four hours), there results a white flocculent precipitate of tribromphenol.

Carbolic acid is antiseptic, disinfectant, irritant, escharotic, locally an anæsthetic, and destructive to all forms of animal and vegetable life. The application of the acid in concentrated form to the skin or mucous membrane produces at once a burning pain, but this is soon followed by numbness and anæsthesia, which extend some distance beyond the site of application. The point touched quickly assumes a marked pallor, due to the effect of the acid in coagulating albumin. If the application has been more prolonged a white, superficial slough results, which afterwards becomes brown, and in the mouth a dry, hard, and leathery appearance follows the swallowing of the acid. The prolonged application of weaker forms of the acid produces blanching, wrinkling, and numbness in the tissues, and if too long continued may cause a painless sloughing. From the application of carbolic acid as a surgical dressing, either in too great a strength or for too long a time, there has more than once occurred such a sloughing, especially in the fingers and toes.

Carbolic acid is absorbed by all mucous surfaces as well as from wounds, and circulates in the blood, probably as an alkaline carbolate. It is excreted by all the emunctories, and especially the kidneys. There has been considerable discussion as to the exact forms in which it appears in the urine; probably they vary with the amount of acid absorbed. It is thought sometimes to appear as oxalic acid, sometimes as hydroquinone, oftener as sulphocarbolic and glycuronic acids, and, after toxic doses, to some degree as unchanged carbolic acid. Its effect upon the kidney itself is important, for it not infrequently causes albuminuria and occasionally, after the absorption of large amounts, total suppression of urine. It not uncommonly happens that the urine of those on whom carbolic acid is being used becomes smoky in appearance, greenish, or even black. This may be apparent when the urine is voided, or it may appear only after it has stood for some time. The exact cause of the symptom is unknown, but it is to be regarded as an early sign of poisoning and requires the cessation of the carbolic-acid treatment. Another early sign of the over-effect of carbolic acid is afforded by an examination of the urine, for carbolic acid in leaving the body by the kidneys has such an affinity for the urinary sulphates that the demonstration of their marked diminution or absence is an important sign of the presence of carbolic acid. For this demonstration Sonnenberg's test is employed. In it the urine is first acidulated with acetic acid, and then a saturated solution of barium chloride is added in excess; if the urine is normal a copious white precipitate of barium sulphate will result, but if carbolic acid is present little or no precipitate will be formed, the sulphates being combined with the acid in the form of soluble sulphocarbolates.

Carbolic-acid Poisoning.—Carbolic acid is a poison of great violence and of great rapidity of action, death sometimes resulting within a few minutes. It is customary to describe two forms of this poisoning, the rapid and the slow. The former is usually a result of the internal administration of the acid and the latter of absorption from surgical dressings. Occasionally, however, it has happened that the external application has given rise to all the symptoms of the acute form, and proved fatal within a very short time. Such a result has followed the rubbing of a solution of the acid on the skin for scabies, and dangerous symptoms have been caused by a single vaginal injection; and it is singular, considering the extensive use of carbolic acid externally and its great rapidity of absorption, that it is not oftener followed by these dangerous results.

The rapid or acute poisoning by carbolic acid, however, is usually a result of its internal administration, and, though in one recorded case death followed the taking of a teaspoonful, and has often resulted from a tablespoonful, on the other hand poisoning after taking 1½ oz. has been recovered from. The symptoms observed in these cases are generally present within a few minutes of the ingestion; they are nausea, loss of consciousness, pallor, cold sweats, contracted pupil, stertor, and stupor passing into coma. The pulse is usually feeble and rapid, but is occasionally very slow. Death results with the victim in collapse. Trismus is occasionally observed, and epileptoid convulsions have been noted. Anæsthesia and loss of reflex motion are sometimes present. If the patient survives, the symptoms of irritation of the alimentary canal are present. The diagnosis is usually easy; the smell of the acid is present, the appearance of the mouth is characteristic, and the urinary signs may be observed. The treatment requires the emptying of the stomach, which, however, must be done by the stomach-tube, for, owing to the anæsthetic action of the acid upon the gastric nerves, emetics are useless. As chemical antidotes we may give a soluble sulphate (usually sodium sulphate), by whose action an innocuous sulphocarbolate is formed; or saccharate of calcium. The saccharate of calcium thus used is made by dissolving 16 parts of sugar in 40 of distilled water, adding 5 of caustic lime, digesting for three days with occasional agitation, filtering, and evaporating to dryness. It is given in solution. The physiological antagonist is atropine.

The slow or chronic form of poisoning by carbolic acid usually results from the use of

that drug in surgical dressings and occasionally from its use by inhalation. It generally gives fair and timely warning of its approach by the smoky discoloration of the urine, but if this is unheeded there occur feebleness, muscular weakness, diminution of cardiac and respiratory strength, vertigo, lowered temperature, and death. The immediate cause of death is respiratory paralysis usually, but occasionally it is syncope. The treatment of this condition consists in the removal of the injurious applications and the free administration of a soluble sulphate.

Carbolic acid is seldom used for internal administration, but there are some conditions in which this employment of it is beneficial, where gastro-intestinal sedation is required or antifermentative action. Thus it is valuable in *nausea and vomiting* from gastric hyperæsthesia, and especially if combined with bismuth. A similar combination, too, is beneficial in *cholera infantum* and *cholera morbus*, as well as in *diarrhœas* in general, if associated with fermentation. *Flatulent dyspepsia* also is relieved by the administration of carbolic acid. Some have thought the acid good in *intermittent fever*, but its value in such cases is, to say the least, inconstant. Bartholow, however, considers its use in combination with tincture of iodine valuable for *malarial cachexia*. The same combination has frequently been used for *typhoid fever* with asserted good results, and Charteris has found the acid alone, given in doses of from 2½ to 3 grains in keratin-coated pills, beneficial in this disease. *Cholera asiatica* has been treated by the administration of carbolic acid, but little success has resulted. The giving of the acid for an antizymotic effect in such infectious diseases as *scarlatina*, *yellow fever*, *erysipelas*, and *diphtheria* has been practised, but it is absurd, for the drug has not the slightest power, when absorbed, to act as a systemic antiseptic. *Hepatic diabetes* is another disease occasionally treated with carbolic acid. In giving carbolic acid internally the usual method of administration is to dissolve the 1- to 3-grain dose in about 1 oz. of sweetened water. Occasionally it is given dissolved in glycerin. The administration should not be oftener than once in two hours, and, if the use is to be even slightly prolonged, careful watch must be had of the urine for the first intimation of renal irritation or of poisoning.

The treatment of *tetanus* by hypodermic injections of carbolic acid (Baccelli's method) is a recent application of the drug, and, though the exact status of the treatment remains to be determined, several cases have been reported cured by it. One of these, reported by Gancel and Frache, was cured in three weeks by hypodermic injections of 0·15 of a grain of the acid every two hours. The action by which the drug cures tetanus was held by these authorities to be antiseptic, though Baccelli himself thought it sedative.

By far the greatest usefulness of carbolic acid, however, is in its external application. As a disinfectant it is of moderate effectiveness only, and, though many bacteria and spores are killed by exposure to a 1- or 2-per-cent. solution, yet many resist, and even a 5-per-cent. solution requires more than twenty-four hours to kill the spores of anthrax. In all cases of disinfection by carbolic acid an exposure of some duration is necessary, and it is the height of absurdity to hastily dip a surgical instrument into a 1-to-20 carbolic-acid solution and think that thus it is cleansed. It is true that some of the weakest of bacteria may thus be killed, but the others are no more disturbed than they would be by a similar dip into water. As a disinfectant of rooms carbolic acid may be of benefit if solutions of considerable strength are used with which to wash the walls and floor, but nothing more ridiculous can be imagined than to expose carbolic acid in vessels about a room, or even to spray it, and to think that thereby the room is disinfected. In the early days of antiseptic surgery a spray of carbolic-acid solution, 1 to 40 (the Lister spray), was kept going in the immediate vicinity of the site of operation, the idea being to destroy the infectious material believed to be present in the air. It certainly had no such effect, and probably brought more bacteria to the wound than it destroyed. It is interesting to note in this connection that the unavoidable inhalation of carbolic acid by those who operated with this spray seemed often to be productive of albuminuria in them, and sometimes of symptoms of some gravity. Even if directly applied to wounds, the usual surgical solutions of carbolic acid can have little effect as disinfectants in the short time occupied in surgical operations.

As a matter of fact, carbolic acid is now much less used in surgery than it was formerly, and it has been largely displaced by corrosive sublimate. It is still used, however, as an antiseptic wash for instruments, because of the injurious effect that the corrosive sublimate has upon them, and yet the solution of carbolic acid generally employed for this purpose (1 to 20) will itself dull instruments in time.

As a deodorizer carbolic acid is inert. It will, of course, disguise foul odours by substituting for them its own very powerful smell, but to destroy these odours (as chlorine does) it has no power, though it may prevent their development by its antiputrefactive and antifermentative action.

Though carbolic acid is relatively feeble as a disinfectant when used in solutions not too strong for safety, yet its antiseptic power is considerable and its local application is, therefore, useful in all *cutaneous diseases* dependent on animal or vegetable micro-organisms. Thus it is used (though less than formerly) as a dressing for wounds, and a 1-to-40 solution is the one usually employed to prevent suppuration in such cases. *Foul ulcers* are similarly treated, as well as *pseudo-membranous inflammations*. In *parasitic skin diseases* the acid is useful and is generally applied in ½- to 1-per-cent. solutions. Though it is rather less active, an oily solution has some advantages for use in skin diseases, or an ointment may be used. Thus are treated *scabies*, *favus*, *tinea tonsurans*, *tinea circinata*, *porrigo*, *pityriasis versicolor*, and parasitic skin diseases in general. In its

application to all such cases, however, the possibility of dangerous absorption and poisoning must not be lost sight of and the use of the drug must be cautious. For the larger number of such diseases, moreover, there are remedies quite as efficient as carbolic acid and far more innocent. In *eczema* accompanied by weeping and itching a cerate of 10 grains of the acid to 1 oz. of simple cerate has been recommended.

The application of carbolic acid to *burns* and *scalds* has the double advantage of antiseptic and local anæsthetic actions, and for such cases a 2-per-cent. solution in olive oil is excellent. For burns, too, are used aqueous solutions of ½ or 1 per cent. and mild ointments.

Solutions of carbolic acid are frequently used for inflammations of the mouth, throat, and respiratory passages. For *stomatitis* and for the various forms of *sore throat* a 1-per-cent. solution is allowable, and a spray of 1 grain to the ounce of water, which later may be increased even to 4 or 5 grains to the ounce, may be used for *nasal catarrh* and *hay asthma* and inhaled in *chronic bronchitis*, *whooping-cough*, *phthisis*, and *abscess* or *gangrene of the lung*.

There is still another way in which the antiseptic powers of carbolic acid are invoked, and that is by parenchymatous injection. For this purpose a 2-per-cent. solution is generally employed, and the injections are made deep into the parts. Among the conditions so treated are *abscess*, *furuncle*, *carbuncle*, *erysipelas*, *lupus*, *chancroid*, *bubo*, and *glands which threaten suppuration*, while in *synovitis* and *ganglion* the injection is made into the synovial sac. In practising these injections the greatest care is to be observed that a vein is not penetrated; to avoid this danger the hypodermic needle is first put in and the injection is not made until it is seen that no blood flows out through it. The frequency of these injections will vary with the case; in acute diseases they may be performed as often as once or twice a day, in chronic cases they are needed less often. The amount of each injection is usually 5 or 10 minims. In *actinomycosis* these injections are said to be beneficial, and 1-per-cent. solutions have even been injected through the thoracic wall and into *phthisical cavities*.

Similar injections are made, not for antiseptic effect but to produce irritation, in *morbid growths* and *chronic inflammatory processes*, with the hope that by the reaction produced a return to the normal condition will result. With this idea injections are made into *hæmorrhoids*, and even *nasal polypi* have been so treated, and for the cure of hydrocele ½ to 1 drachm of the crystals of carbolic acid have been liquefied by heat and thrown into the *tunica vaginalis*.

The destruction of *nævi* is accomplished in a similar way. Dr. S. Sherwell, of Brooklyn, has practised and described a method to which he gives the name "tattooing." This method consists in the puncturing of the affected area, a portion at a time, with a number of keenly sharpened needles bound together and dipped into an aqueously liquefied carbolic acid (50 per cent., or stronger). The area is subsequently cleansed with alcohol and protection and pressure are provided by the free application of collodion. The results are said to be excellent and scarring little or none.

The anæsthetic power of carbolic acid is well known, and a familiar example is seen in the relief of *toothache* by packing the cavity of a carious tooth with a bit of cotton soaked in a concentrated solution of the acid. This effect of the drug on the sensory nerves is occasionally turned to account by painting a rather strong solution over the painful area in *neuralgia*, and a lotion is much employed to allay itching in *skin diseases*. For this purpose a lotion of 3 drachms of carbolic acid, 1 oz. of glycerin, and 1 pint of water is excellent, though in all such uses the possibility of harmful absorption must not be forgotten. The drug has been employed for local anæsthesia in the performance of minor surgical operations, and for such purposes as the opening of *felons* it has been recommended by Bill to first soak the finger for fifteen minutes in a warm 3-per-cent. solution of carbolic acid and then to paint along the line of incision with a brush dipped in a concentrated solution.

Finally, carbolic acid in concentrated form is used as a caustic for the destruction of *morbid growths* and unhealthy processes. For this purpose it is applied in a liquid form, produced either by the addition to the crystalline acid of the smallest amount of water required to liquefy it, or by melting the crystals by exposing them to gentle heat, and this may conveniently be done by placing the bottle containing the acid in a vessel of hot water. The caustic effect of the acid is very superficial, however, and its utility as an escharotic is therefore confined to small and not extensive growths. Thus are treated *chronic uterine endotrachelitis* and *chronic endometritis*, *ulcers of the cervix uteri*, *corns*, *warts*, *mucous patches*, *condylomata*, *vegetations*, *lupus*, *nævus*, and *unhealthy ulcerations*.—Henry A. Griffin.

CARBON AND ITS GASEOUS COMPOUNDS.—Carbon is not used in medicine except in the form of charcoal and anthracite coal, to the articles on which the reader is referred, but it is as well to mention that when in a minutely subdivided state and combined with the proper proportions of air it is highly explosive, and that many of its compounds, such as sugar, flour, etc., also possess this property. The most interesting and important of its gaseous compounds, from a medical standpoint, are *carbon monoxide*, CO, and *carbon dioxide*, CO_2, or *carbonic-acid gas*, together with a number of gaseous members of the hydrocarbon series which are used in the arts and enter largely into the composition of illuminating gas. Carbon dioxide is the most important product of the perfect combustion of the various carbonaceous fuels, is widely distributed through Nature in combination with the various bases in the form of carbonates, is found in many mineral waters, accumulates in wells and mines, and is given off in nearly all

the fermentative processes to which organic bodies are liable. Commercially it is obtained by the action of acids upon limestone, but it is also collected directly from mineral waters highly charged with it, and distributed in cylinders in a fluid state. It is a colourless, incombustible gas, more than half as heavy again as atmospheric air, has a pungent odour, is totally irrespirable, and is slightly narcotic. Under the ordinary atmospheric pressure water absorbs and retains a volume of carbonic acid equal to its own bulk, and for each increase of an atmosphere in pressure a similar volume is absorbed. When the gas is subjected to a pressure of about 50 atmospheres at a temperature of 60° F. it is converted into a clear liquid.

Combined with water by means of pressure, it is known as *soda water*, or *carbonic water*, which is used to allay thirst, to decrease nausea, and as a vehicle for the administration of the various alkaline carbonates and saline cathartics. It is often combined with milk to render it more palatable and assist in its digestion, being substituted for lime water when constipation exists, and, on account of its slight stimulant effect upon the stomach, it is employed with benefit in all forms of gastric distress. To the presence of this gas nearly all the effervescing preparations and sparkling wines owe their influence in relieving nausea. In sickness, and indeed in health, carbonic water is a very desirable diluent for all forms of alcoholic stimulants, and when mixed with any mucilaginous body it nearly disguises the taste of castor oil and other nauseous drugs. In some cases of *leucorrhœa* and *uterine troubles* it forms a slightly stimulating douche, but is rarely used for these purposes save at the various springs which contain considerable quantities of it. Its use is to be avoided, as a rule, in all cases where there is a tendency to the formation of flatus, as it is apt to increase the unpleasant sensations caused by the accumulations of gas. *Old ulcers* which are slow to heal under ordinary treatment may sometimes be benefited and the pain of *cancer* often alleviated by its topical use. Its slight narcotic properties have suggested its use as an anæsthetic in minor surgical operations, the extraction of teeth, etc., but it is of little value as such and, moreover, is more or less dangerous; like nearly all gaseous bodies, its administration by the rectum has been suggested in the treatment of *phthisis*, but no marked good results have followed its employment. A stream of the gas itself has sometimes been allowed to impinge upon the posterior wall of the pharynx in cases of *migraine*, and in some instances with very good results.

[The infusion of carbonic-acid gas into the rectum has been considerably employed by Dr. Achilles Rose in cases of *chronic dysentery, the vomiting of pregnancy, whooping-cough, prostatitis*, and *impotence* (*N. Y. Med. Jour.*, March 9, 1885, p. 291). The results observed by Dr. Rose show that the gas is often of decided benefit in these conditions. He cautions against the forcible introduction of the gas under pressure, especially in pregnant women, as it gives rise to abdominal distress and may be dangerous. By a simple device described by him carbonic-acid gas may be evolved slowly by adding large crystals of tartaric acid to a solution of sodium bicarbonate in a wide-mouth bottle the stopper of which gives passage to a tube that terminates above the surface of the solution and to the outer end of which is attached a piece of rubber tubing of convenient length, furnished with a proper nozzle for introduction into the rectum.]

As carbonic acid unites readily with metals to form carbonates, it is of the utmost importance that all vessels, etc., employed in the manufacture and storage of this gas and of carbonic water should be made of or lined with some substance not easily affected by it. Iron and steel vessels are the safest, but if any other metals are used they should be lined with pure tin or some enamel or glass. Many cases of copper and lead poisoning have occurred which were directly traceable to improperly tinned lead or copper pipes of soda-water fountains. The presence of the gas in wells, cellars, fermenting vats of breweries and distilleries, etc., can easily be detected by the introduction of a lighted candle, which will either be extinguished or burn feebly if sufficient of the gas is present to render the air irrespirable. This plan, however, is not safe if the suspected locality is confined, as there is always a possibility that carbon monoxide, or marsh gas, may be present, in which event an explosion would be apt to occur. Wells and small spaces may be rendered safe by exposing in them unslaked lime or freshly prepared lime water, and often thorough agitation of the air is enough. When it becomes necessary to enter such localities to remove persons who have been overcome, it is a good precaution to apply a sponge wet with lime water over the nose and mouth. Normally carbonic-acid gas is found in the atmosphere in the proportion of about one part in 2,500, which quantity can be increased without any appreciable evil effects to one in 1,000; but when it reaches one in 200 most persons are affected with a feeling of languor and headache. Higher contamination than this rapidly causes insensibility, and when the volume of the gas reaches about one twelfth that of the air suffocation occurs. When it is introduced into the stomach or the peritoneal cavity, or when a large part of the surface of the body is exposed to its action, no poisonous effects are observed. Its poisonous action depends almost entirely upon the fact that when it is combined with the air in dangerous proportions a mixture is formed of such specific gravity that the transfusion of the gaseous waste products of the body through the walls of the pulmonary capillaries is prevented. Its narcotic properties are hardly of sufficient activity to play a very important part in causing death. The usual symptoms in what may be termed *acute carbonic-acid poisoning* are stertorous and oppressed breathing, a feeble pulse, a flushed face, and often a swollen tongue. The post-mortem appearances are not particularly distinctive, and resemble those seen in cases of asphyxia from other causes. The blood is, as a rule, very dark-col-

oured. In the treatment of this form of poisoning the person should be placed in an upright sitting posture, the clothing loosened, cold affusions applied to the face and chest, heart stimulants administered, frictions of the surface made, oxygen, if it is at hand, inhaled, and artificial respiration practised. In cooks and others who spend large portions of their time in places vitiated by this gas a form of anæmia is observed which is easily relieved by their going to work in a pure atmosphere. The dulness and languor of those who live and sleep in rooms heated by stoves and furnaces from which the products of combustion escape is due in great measure to this gas, and the cure for them need hardly be indicated. It has been estimated that a gas-burner consuming 6 cubic feet of gas an hour will give off as much carbonic-acid gas during a given period as an adult will in the same time, and thus brilliantly lighted rooms may be rendered unwholesome in a very short period. Illuminating gas itself contains a varying amount of it, but this is of little importance, as the other constituents are irrespirable.

Carbonic oxide is by far more dangerous to life than the dioxide, is almost insoluble in water, does not combine with the commoner bases, is inflammable, is a trifle lighter than air, and when one volume is combined with 100 of the latter the mixture is entirely unfit for respiration. It is formed in large quantities in the combustion of coal, and when this is perfect it should be converted into the dioxide. When charcoal is burned in brasiers and in confined localities, carbonic oxide is given off in large quantities and is the cause of death in many cases rather than, as is commonly believed, the dioxide. It forms the larger portion of the producer gas used so largely in the various metallurgical processes, and constitutes nearly one third of the volume of water gas, or oil gas, which has been substituted so largely for coal gas, which latter contains about one twentieth of its volume of it. Fuel gas, which was formerly used in a number of cities, is formed by passing steam through incandescent carbon, and consists of a mixture of about equal parts of this gas and of hydrogen. It is nearly odourless, and has been abandoned after having caused a large number of deaths by its escaping from leaky pipes into cellars, etc. Upon the first introduction of water gas it met with considerable opposition on account of the large amount of the monoxide it contains, but finally it was agreed upon that no form of illuminating gas was respirable, and that one was about as dangerous as another. It is certain, however, that a smaller volume of water gas than of coal gas is needed to vitiate the air of a room, and that in combustion it gives off more dioxide. The symptoms of *carbonic-oxide poisoning* do not differ essentially from those given in speaking of the dioxide, but if illuminating gas has been the agent the breath will have a strong odour of it. After death the body is apt to retain its heat for a considerable time, the cornea remains bright and clear, erythematous patches appear on different portions of the body, and the genitals become red and more or less tumid. It has been observed sometimes that when dogs have been poisoned by illuminating gas there is a marked sexual excitement shortly before death occurs. The blood is usually brightly coloured, and this is due to the quite stable compounds which carbonic oxide forms with the hæmoglobin. The blood may have the characteristic odour of the gas. In addition to the treatment to be adopted in poisoning by the dioxide, it is often necessary to withdraw a portion of the venous blood and return it after having whipped it up to expose it thoroughly to the action of the air, or replace it with that taken from another person. Convalescence is apt to be prolonged and accompanied by vague symptoms of affections of the nervous system. The vapours given off in the various processes in the manufacture of illuminating gas sometimes overcome persons exposed to them, but, being those of hydrocarbons, they are not usually followed by any serious results unless the person remains exposed to them for some considerable period. The treatment adopted for these cases in gas works consists in cold affusions and the use of ammonia, and is usually entirely effectual. It may be mentioned in this connection that a popular treatment for *whooping-cough* consists in the inhalation of the fumes from the lime used in purifying coal gas, and that in a measure it does relieve the paroxysms of coughing. What particular body it is that has this effect it is impossible to say, as there are so many of them, but the principal ones are sulphur and ammonia compounds, cyanides and cyanates, and various hydrocarbons. The lime from water-gas works is entirely without effect, containing little but sulphur compounds and calcium carbonates.

Russell H. Nevins.

CARDAMOM, *cardamomum* (U. S. Ph.), *cardamomi semina* (Br. Ph.), *fructus cardamomi* (Ger. Ph.), the fruit of *Elettaria Cardamomum*, a scitamineous plant of Malabar, is an aromatic tonic. Cardamom is seldom used alone, but it enters into the composition of many preparations. The dose is from 4 to 8 grains. Its preparations are used chiefly as corrigents. The dose of the simple tincture, *tinctura cardamomi* (U. S. Ph.), is 1 fl. drachm. The compound tincture, *tinctura cardamomi composita* (U. S. Ph., Br. Ph.), is the preparation more commonly used. The dose is from ½ to 2 fl. drachms. The U. S. Ph. directs the use of diluted alcohol in making it, while the Br. Ph. orders the use of proof spirits, and the consequent greater alcoholic strength of the British preparation is to be borne in mind in deciding upon the dose.

CARDIAC STIMULANTS, TONICS, AND DEPRESSANTS. — These three classes of remedies are among the most important in the medical armamentarium. The first are constantly called for in the treatment of emergencies, such as injuries or poisoning, accompanied by *great depression of the vital powers, collapse*, and *shock;* in many of the acute diseases, whether infectious or not, in

which, sometimes from the beginning, as in typhus and diphtheria, sometimes later in their course, as in typhoid fever, pneumonia, senile bronchitis, etc., there is developed a condition of *nervous adynamia*, or a *general asthenia*, which seriously threatens the welfare of the sufferer; or in exhaustion from too great fatigue, prolonged vigils, or continued emotional strain, by which the cardiac and vascular innervation is profoundly affected.

The cardiac sedatives are in as frequent demand in general practice. They are, of course, indicated in all states which are accompanied by *abnormally forcible action of the heart*, usually associated as it is with high arterial tension. Such a condition is met with in the early stages of most of the continued fevers, as well as at the beginning of the paroxysms or exacerbations of those of the intermittent or remittent type; in most acute inflammatory troubles, and in some cases of central nervous disturbance arising from a variety of causes. There are also chronic diseases, such as exophthalmic goître, some forms of renal disease, and the recurrent paroxysms of excitement in some of the forms of insanity—*e. g.*, circular insanity, paranoia, chronic mania, or the crises of locomotor ataxia, in which the depressors of the force of the circulation are extremely serviceable if judiciously administered.

The cardiac tonics have their field of action mostly in the department of chronic diseases, in *general debility* from whatever cause, and in convalescence from severe injuries and diseases which have sapped the strength, have reduced the anabolic or constructive processes of nutrition to a low ebb, and frequently leave the tissues and organs in such a devitalised condition that the normal status is regained with difficulty. Under the latter circumstances the vital resistance to unfavourable influences is so feeble that there is constant danger of the body's succumbing to some of them.

This is observed in the frequency, no doubt exaggerated by some authors, with which enteric or typhoid fever is followed by tuberculosis, for it is acknowledged that healthy tissues with, necessarily, a normal circulation through them of properly elaborated blood and lymph, offer no nidus for the development of colonies of the *Bacillus tuberculosis*.

The indications for the use of **cardiac stimulants** are, as a rule, so plain that there is not much danger of their unnecessary employment. There is, rather, some danger of a misinterpretation of symptoms on the part of an inexperienced, busy, or overtired practitioner which may result in their neglect at a time when they might be of great service to the patient. The two principal misleading signs are a too rapid and *apparently* too forcible heart beat and too great rapidity of the radial pulse when it is, or may be, regular and of fair volume. These mistakes are, however, easily avoided by remembering always that a rapid beat is not necessarily, by any means, a strong beat; that the strong thumping of the apex against the chest walls may and often does indicate an ineffectual beat, the heart, agitated in consequence of its abnormal irritability, struggling perhaps to keep up the circulation with an insufficient amount of blood; and that a moderate or large volume of the pulse may be due simply to the fact that, from defective innervation, the arterial coats do not contract firmly upon the contained mass of blood.

The forcible apex beat of *anæmia* seems at first sight paradoxical. But its character is, in all probability, not due to any increase in the force of the contraction of the muscular wall of the heart, which must necessarily be weakened, like every other muscle of the body, by an insufficient blood supply. The fact is that, the cavities not being well distended by blood during the period of relaxation, the ventricles do not meet with proper resistance either within or without when they contract, and they are on that account thrown into an abnormal position. It has been observed, in the slowly contracting heart of a reptile, which continues to act for hours after decapitation if the organ is kept moist, that as the blood diminishes in quantity and as the cardiac walls gradually become weaker, the position assumed during the systole may change very decidedly, and it is reasonable to suppose that something similar may occur in the human subject. A comparison of the heart beat with the radial pulse will settle all doubts as to the actual force of the contractions.

The principal and most valuable cardiac stimulants are ammonia; ether; the oil of turpentine; alcohol; the essential oils, especially eucalyptol; hot coffee and tea; dry heat; and (in case of great emergency, such as is found in *impending death from suffocation*, *immersion*, *extreme shock* and *collapse of the circulation* and *respiration* under the influence of chloroform) mechanical irritation by intermittent pressure on the præcordium or acupuncture. As regards atropine and morphine, in order that their effect may be prompt enough to be called stimulating, it is necessary that they should be administered hypodermically. The word stimulating connotes or implies rapid action when used in the therapeutic sense. And this is one of the chief virtues of this class of drugs, that, if they are productive of any noticeable effect, it is rapid in its appearance. The need also is urgent in the cases to which stimulating remedies are particularly applicable. It follows that no time should be lost in examining the patient and determining whether it is safe or not to rely upon the stomach.' When shock is profound, or the syncopal state is present, it may be even impossible to introduce anything into the stomach without the aid of a tube, which is not altogether safe, even in the most experienced hands. We must, then, resort to either rectal or hypodermic injection as circumstances seem to make one or the other advisable. Of course, if a hypodermic syringe is at hand, as it always should be, it is altogether our most reliable means of getting such agents into the system. For, even in the most profound shock or in various comatose states, the rectum may expel an enema before time enough has elapsed for its absorption. Fortunately, all the cardiac

stimulant drugs except turpentine and the essential oils are available for this purpose. Alcohol of 50-per-cent. dilution, as it occurs in the different spirituous liquors, may be used without the further addition of water. The strong liquor ammoniæ should be used in quantities of not over 5 minims, diluted with at least ten times its volume of water, and preferably with more. If it is too strong it will cause sloughing of the tissues, and perhaps not undergo any perceptible absorption. The aromatic spirit of ammonia may be used without dilution. If there are proper facilities present, alcohol in the form of vapour may be used according to the method described under ALCOHOL. The vapour of ammonia is also of use, but should not be too roughly employed; and where the cerebral anæmia is very great, as we see it in some alarming cases of *syncope*, the vapour of nitrite of amyl is one of the best of all restoratives. The latter may also be used hypodermically in doses of from 5 to 10 minims. It should never be forgotten that, so soon as the heart shows the effect of the stimulant, either its use should be discontinued or the dose be diminished. Of course, such details of treatment can only be determined by the physician or surgeon in charge of the case, and he should, above all, not leave the patient until safety during the interval is, as far as possible, guaranteed. To trust to the judgment of any nurse or attendant in a case which really and urgently requires the exhibition of cardiac stimulants is to lean upon a broken reed, to forsake one's post of duty, to expose the patient to extreme peril.

The efficient employment of **cardiac sedatives** in medical practice requires skill and a power of nice discrimination. The principal and most reliable members of the group are, so far as drugs are concerned, the following: Antimony, in the forms of its potassiotartrate and antimonial wine; mercury, usually given for this purpose as calomel; aconite; veratrum, veratrum viride being the variety exclusively in use by physicians at the present day; sulphate of veratrine; and the newer coal-tar preparations, antipyrine, acetanilide, and phenacetine. When *cardiac* or *cardio-vascular excitement* is the reflex product of local irritations, especially when such irritations are located in the stomach or lower portions of the primæ viæ, the exhibition of small and frequently repeated doses of opium, codeine, or morphine may indirectly allay the disturbance. For the same purpose hydrocyanic acid is useful. In such constitutional conditions as *rheumatism* and *gout* full doses of the alkalies in the one case, or of colchicum in the other, will, by removing the cause, indirectly relieve the symptom. Finally, the direct application of cold over the heart or, in febrile states, the general use of the cold bath to reduce the bodily temperature is most efficacious in relieving cardiac overaction. In local inflammatory diseases, where the fever and vaso-motor disturbance are symptomatic, as in *pneumonia*, *pleurisy*, *pericarditis*, *peritonitis*, etc., the drugs above enumerated are valuable adjuncts to the treatment, and should be employed in small but frequently repeated doses. The hydrotherapeutic plan is more applicable to the essential fevers, where we may greatly profit by abstracting heat from the whole body at once, although, at times its local abstraction is a great aid.

Cardiac tonics may in one sense be said to include all tonics, for any drug or agency, material or immaterial, which tends to the improvement of the general health may fairly be said to have its tonic effect on the heart. And this may be said, not only of those agents which are generally classed as tonics, but also of many others which, by removing effete or poisonous matters from the system or restoring the functions of deranged parts, give the organism an opportunity to resume its healthy status. There are, however, certain drugs which from their more pronounced effect upon the heart and arteries deserve to be considered as the cardiac stimulants *par excellence*. These drugs are digitalis; convallaria maialis; sparteine; strophanthus; cactus grandiflorus; and, in small doses, strange as it may seem, sulphate of veratrine. Besides these, opium, morphine or codeine, and sulphate of atropine, *in small doses*, are useful, but the former should, for this purpose, be used without the patient's knowledge. Aside, however, from the substances named, iron, which is always put among the general tonics, might fairly claim a place here. Indeed, it is questionable whether, as its most evident effects are upon the blood and the blood-vessels, iron should not be entirely transferred to the list of cardiac or cardio-vascular tonics, and placed at the head of it. It is certain that in degenerative conditions, particularly *fatty degeneration of the heart*, there is no remedy so useful as iron, although the good resulting from its use may be increased by its combination or alternation with digitalis. Quinine also, though a general tonic, has, through its effect on the nervous mechanism, a salutary influence upon a weakened or, especially, a depressed circulation. Arsenic, again, which ranks perhaps above all the nerve tonics, exerts, like quinine, a roborant influence over the circulatory apparatus, and in its combination with iron we have an unexcelled cardiac tonic. Cactus grandiflorus and sulphate of veratrine have their most important function in steadying and slowing the rhythm of the heart.

In addition to the drugs mentioned, the use of bathing, local and general, is one of the most useful of our resources in cases in which the vascular tone is to be restored. (See HYDRIATRICS.)

In the consideration of these agents for impressing the circulation I have purposely omitted to speak of electricity, because its use is not devoid of danger when a current of sufficient electro-motor force to penetrate to the heart is employed, and the rules for its management have not been satisfactorily formulated. I may say, however, that my experience seems to justify the statement that a person who cannot be benefited by any of the above-mentioned substances or agencies would de-

rive no good from electricity applied by any of the methods known to us at present.

BENJAMIN F. WESTBROOK.

CARDINE.—This name has been given to an aseptic glycerin extract of the muscular tissue of the ox's heart made by cutting the fresh tissue into small pieces, after the organ has been thoroughly washed in a saturated solution of boric acid, macerating it for eight months in a mixture of 10 parts each of glycerin and saturated boric-acid solution and 8 parts of alcohol, with daily agitation, decanting the supernatant liquid, and filtering both that liquid and the juice that can be squeezed out of the macerated cardiac tissue by means of strong pressure. (For general information concerning such preparations, see ANIMAL EXTRACTS AND JUICES.) Dr. William A. Hammond considers cardine capable of exercising a special tonic action upon the affected organ in cases of *disease of the heart.* Cardine is employed hypodermically in doses of 30 c. c.

CARDUUS BENEDICTUS.—See CENTAUREA BENEDICTA.

CARICA PAPAYA.—See PAPAW.

CARMINATIVES are remedies used for the purpose of expelling *intestinal flatus* and preventing the *griping* attending the operation of many purgatives. Nearly all of them depend upon the presence of an essential oil for their effects. Ginger, sage, spearmint, fennel, peppermint, and pennyroyal are familiar examples and fair representatives of this class, and play a very important part in household medicine in the shape of hot infusions. It is the common practice to add sugar to these infusions, or teas, as they are commonly called, to render them more agreeable to take; but it is extremely objectionable, as it only furnishes material to maintain the fermentative processes which are at the bottom of the conditions they are intended to relieve. The essences, or spirits, of peppermint and of anise are largely given to young infants with colic; but they are not to be recommended for this purpose, as the relief they give is only temporary, and, moreover, they are very apt to disturb the patient's digestion and perpetuate the trouble. A few drops of sweet spirit of nitre are just as effectual and do not disorder the digestion, but, unfortunately, mothers and nurses object to it on account of its diuretic properties, which render more frequent changing of the diapers necessary.

Among the old-fashioned untrained nurses, a class now happily obsolescent, it was the common practice to tie sugar soaked in essence of anise in a bag, and the instant that an infant, no matter how young, showed the slightest signs of uneasiness, to cram this "sugar-teat" into its mouth. As the same bag was used again and again, it is easy to imagine the effect upon the digestion. If the various essences and tinctures of the essential oils were applied externally they would be just as effective and infant mortality would be greatly diminished. The indiscriminate use of carminatives for infantile troubles is almost as reprehensible as that of opium, and is beyond doubt the cause of a very large number of fatal cases of cholera infantum. Poultices of the leaves of the various species of mint or of pennyroyal, gentle rubbing of the abdomen, plain hot applications, and often the administration of a few drops of hot water, are all that are necessary to relieve *colic in infants* in the very great majority of cases. The colic which accompanies infantile diarrhœa should never be treated with carminatives, as the essential oil they contain, although it may relieve the pain for a while, is irritating to the mucous membrane of the alimentary canal, and thus should not be used in any condition in which there is any irritation of the intestines. The official waters of peppermint or of cinnamon and the spirits of nutmeg are the most desirable preparations to be used when the irritant effect upon the stomach of many salts, such as potassium bromide, is to be counteracted. Coriander, cardamom, and ginger are the ones most commonly combined with griping cathartics. Opium and oil of turpentine, although used for the same purposes as carminatives, are hardly to be classed as such. (See ANISE, CARUM, CARDAMOM, CORIANDER, CLOVES, FENNEL, GAULTHERIA, LAVENDER, MENTHA PIPERITA, MENTHA VIRIDIS, PENNYROYAL, and SALVIA, and cf. ASAFŒTIDA.)

RUSSELL H. NEVINS.

CARPAINE is an alkaloid obtained from the leaves of *Carica Papaya.* Its hydrochloride, which is freely soluble in water, is said to have been employed with advantage in the treatment of *diseases of the heart,* especially *mitral insufficiency* and *aortic stenosis,* and Dr. Cerna speaks of it as having been considered the only substitute for digitalis. According to Rünke (quoted by Husemann), however, its action is quite the reverse, for it paralyzes the heart. Further experience, therefore, is necessary before its internal employment can be sanctioned. A drop of a 1-per-cent. solution, applied to the conjunctiva, is said to cause in the course of a few minutes complete anæsthesia of the eye which lasts for half an hour.

CARRAGEEN (Ger. Ph.).—See CHONDRUS.

CARRON OIL.—An emulsion of about equal parts of lime water and linseed oil, used as a soothing and protective application to superficial *burns.*

CARUM (U. S. Ph.), *carui fructus* (Br. Ph.), *fructus carvi* (Ger. Ph.), *caraway,* is the fruit of *Carum Carvi,* used as an aromatic and carminative. The dose is from ½ to 1 drachm. A distilled water of caraway, *aqua carui* (Br. Ph.), may be given in doses of from ½ to 2 fl. oz. The volatile oil, *oleum cari* (U. S. Ph.), *oleum carui* (Br. Ph.), *oleum carvi* (Ger. Ph.), is used in doses of from 1 to 4 minims.

CARVACROL, an isomer of *carvol,* $C_{10}H_{14}O$, is derived from caraway seeds. A so-called *iodide of carvacrol,* made like aristol, except that carvacrol is employed instead of thymol, has been used externally as a substitute for iodoform.

CARYOPHYLLI (Ger. Ph.), **CARYOPHYLLUM** (Br. Ph.), **CARYOPHYLLUS** (U. S. Ph.).—See CLOVES.

CASCARA SAGRADA.—See Rhamnus purshiana.

CASCARILLA (U. S. Ph.), *cascarillæ cortex* (Br. Ph.), *cortex cascarillæ* (Ger. Ph.), is the bark of *Croton Eluteria.* It is an aromatic stomachic tonic and astringent. The *infusum cascarillæ* (Br. Ph.) is given in doses of from 1 to 2 fl. oz.; the dose of the *tinctura cascarillæ* (Br. Ph.) is from ½ to 2 fl. drachms.

CASCARIN.—See Rhamnin.

CASHEW NUT, the nut of *Anacardium occidentale,* has been used as a topical application in obstinate cases of *eczema* and *psoriasis* and internally as a remedy for *impotence* and for *general debility,* such as that resulting from influenza or some severe acute disease. An unofficial tincture, made by macerating 1 part of the powdered nut in 5 parts of alcohol, is given in doses of ½ fl. drachm.

CASSIA ÆTHIOPICA, CASSIA ACUTIFOLIA, CASSIA ALBA, CASSIA ANGUSTIFOLIA, CASSIA ELONGATA.—See Senna.

CASSIA FISTULA (U. S. Ph.), *cassiæ pulpa* (Br. Ph.), is known popularly as purging cassia, and is the fruit of a tree native to Egypt and to India, though cultivated elsewhere in tropical climates. The fruit occurs in the form of dark, cylindrical pods, varying between 1 and 2 feet in length and of a diameter usually of about 1 inch. Within, the pod is divided into numerous cells each containing a seed embedded in a dark-brown pulp. This pulp is the portion of the fruit employed, and is possessed of an odour somewhat resembling that of prunes and a sweetish, acidulous, mucilaginous, and not disagreeable taste. The amount of sugar contained in this pulp is said to be 60 per cent.

The U. S. Ph. recognises the fruit itself as official, but as a matter of fact it is only the pulp of the fruit which is employed. This is laxative in doses of from ½ to 1 drachm, and purgative in doses of ½ oz., but even in the smaller doses it manifests a marked tendency to cause pain and griping, and hence is rarely used alone. As a purge it has nothing to recommend it as compared with other purgatives, and the griping from its use is a strong point against it. As a laxative, however, and used in combination with other drugs as corrigents and adjuvants, it is an agreeable and efficient remedy. The combination in which it is usually employed is the confection of senna.

Henry A. Griffin.

CASSIA LANCEOLATA, CASSIA MARYLANDICA, CASSIA OBOVATA.—See Senna.

CASSIA OCCIDENTALIS.—The seeds of this plant have been highly recommended as a tonic, and as a remedy for *remittent* and *intermittent fever* in cases in which quinine has failed. An infusion of ½ oz. of the seeds in ½ a pint of water may be taken in two or three doses in the course of a day. The leaves are said to have the same medicinal virtues as the seeds, and the root is reputed tonic and diuretic.

CASTANEA (U. S. Ph.).—The leaves of the common chestnut tree (*Castanea dentata*) gathered in the late summer and early autumn. They appear to have a special sedative effect upon the respiratory centres and nerves, and have been used with considerable success in relieving the paroxysms of *whooping-cough.* For this purpose an infusion of 1 oz. of the dried leaves in 1 pint of boiling water is the form generally preferred, and it may be given in almost any quantity desired, as no evil results have been known to arise from its use. It also possesses slight astringent properties and is a domestic remedy for mild cases of *diarrhœa.* The fluid extract, *extractum castaneæ fluidum* (U. S. Ph.), may be used in doses of from ½ to 1 fl. drachm. The bark is astringent, but is rarely used except when nothing else of that nature is at hand.

The bark of *Castanea pumila,* or *Chinquapin,* is slightly astringent.—Russell H. Nevins.

CASTOREUM, or *castor,* is, strictly speaking, the contents of the preputial follicles of the castor or beaver, an unctuous matter; but practically and commercially the dried follicles with their contents. Castor is obtained from several species of beaver, the most common source being the American beaver (*Castor americanus*). The castor so obtained occurs in pairs of pyriform sacs, dry, wrinkled, and brown, the matter contained being brown and dry. The odour is aromatic, the taste bitter. The activity of this material is believed to depend upon a crystalline matter contained in it, to which the name of castorin is given, as well as upon a volatile oil.

Castoreum is no longer official, but the U. S. Ph. of 1870 and the Br. Ph. of 1867 recognised it and authorized a tincture, *tinctura castorei.*

The physiological action of castor is in every way akin to that of musk, though generally much weaker. Its power depends upon a stimulating action upon the nervous system, seen especially in conditions of *nervous exhaustion,* and upon its action as a nervine, particularly in *hysterical manifestations.* Castor is also a mild cardiac stimulant. The therapeutical applications of castor are few, but it seems of value in hysterical convulsions and hysterical manifestations in general. In *hiccough* it is said to act well, though it is less reliable than musk. In the condition of nervous exhaustion seen in febrile diseases of adynamic type, a condition to which the name "*typhoid state*" is sometimes given, from its more common occurrence in typhoid fever, the effect of castor is occasionally excellent. From its use here an invigorating and a stimulating of the vital forces appear to result, the cerebral symptoms becoming less marked and the circulation stronger. The action of castor is, however, usually exceedingly mild—milder than that of musk.

The dose of castor usually ranges from 15 to 60 grains, and it is generally administered in mucilage; that of the tincture is from 10 to 20 drops.—Henry A. Griffin.

CASTOR OIL, *oleum ricini,* is a yellowish oil of a nauseous taste expressed from the

seeds of *Ricinus communis*, a plant found native in tropical and subtropical climates and cultivated extensively in the temperate zones. The seeds contain an active principle which is highly poisonous, causing emeto-catharsis and collapse. Many fatal cases have occurred in children who have eaten them. The treatment of this condition consists in the use of stimulants and measures to support the strength. Where the end to be attained is the thorough emptying of the entire contents of the intestines castor oil is the most appropriate cathartic we have and can as a rule be used with perfect safety. In an insignificant number of instances there seems to be some idiosyncrasy by reason of which it causes a degree of collapse which is at times alarming. Its action is quite speedy and thorough and is attended by little irritation of the intestinal mucous membrane. With the exception noted above, the sole drawback to its use is its nauseating taste and odour, which in many persons entirely forbid its use. Innumerable methods have been proposed for overcoming this objectionable feature, all of which are intended to prevent the contact of the oil with the mouth. Many of them are entirely successful, provided the repugnance of the individual can be overcome. Its admixture with milk, coffee, or beef tea is often practised, but is not advisable, as, in case the oil taste is not entirely disguised, an almost insurmountable disgust for whatever is used is established, which, when an article of food is concerned, is not desirable. Mixed with the froth of ale, beer, porter, or soda water, it is easily taken without its presence being noticed. If none of these are attainable, or if there is any objection to their use, a mixture of gelatin, gum arabic, or gum tragacanth and water, flavoured with lemon-juice or orange-juice, is readily beaten into a froth with which the oil can be incorporated. Rinsing out the mouth with tincture of camphor, any form of spirits, or glycerin and pouring a small amount of whichever is used on the oil answers every purpose in many instances. The essential oils have been recommended for the same purpose, but as a rule they are not very serviceable. After its administration it is well to avoid the drinking of fluids for an hour or so, to prevent eructations.

The average cathartic dose for an adult is from ½ to 1 fl. oz., but if an equal amount of glycerin is added to the oil the dose need be only half as large as when the oil is used alone. Its use for any protracted period is not advisable, as it is apt to be followed by constipation. But this can be obviated somewhat by progressively diminishing the size of the dose. In large doses it apparently causes slight drowsiness. As it usually operates in about six hours, it must be taken either in the morning or late at night.

In cases where there is *diarrhœa* with the passage of undigested food it is by far the best cathartic that can be used, and as a rule the trouble is entirely relieved by a single dose. In such cases in very young infants it is usually better to give small doses, say from 5 to 10 drops at intervals of an hour, until the stools begin to appear more nearly normal and the undigested food disappears. *Cholera infantum* is in a certain proportion of cases treated with entire satisfaction by 1-drop doses given every hour until the symptoms are relieved, but unfortunately there are no means of determining in advance which are the cases appropriate for this treatment. In pregnancy and after surgical operations, where a full movement of the bowels is desirable with as little general disturbance as possible, it is the best cathartic to use. In *painful hæmorrhoids* and *fissure of the anus* it may be said to be the only one admissible. No other cathartic is so commonly used after the administration of a mercurial purge, and for this purpose it leaves little to be desired. On the other hand, it should not be administered after aspidium has been given, as in some cases it has seemed to facilitate the absorption of the active principle of that drug. Although this danger is somewhat remote, as there is no particular indication for its use in such cases, it is as well to be on the safe side and make use of some other cathartic. The commonest condition in which this oil is used is *constipation* in adults and infants, especially when the tongue is thickly coated and the breath offensive, and under these conditions it is eminently useful, provided its use does not exceed more than two or three doses, for if it does, as has already been pointed out, it may aggravate the condition for the relief of which it is used. The addition of from 10 to 20 drops of laudanum will prevent the griping which sometimes occurs, and a popular addition for this purpose is an equal bulk of oil of turpentine, but this amount is rather dangerous, for, if prompt catharsis does not occur, the whole labour of excreting the turpentine is thrown upon the kidneys, often causing strangury. In conditions where there is depression, from 10 to 20 drops of the turpentine oil may be added with advantage. In *dysentery* of a mild type 30-drop doses, emulsified with a solution of gum tragacanth, and with from 10 to 15 drops of laudanum added if there is much pain or tenesmus, given every four hours, are good to begin, and they prove successful in a large number of cases. The homely method of breaking up a *cold* at its inception by a full cathartic dose at bedtime is a very good one, as it undoubtedly establishes free secretion from the bronchial mucous membrane.

From 1 to 2 oz. may be incorporated in an enema, but it has no advantages over any other oil and is rather more offensive. Nursing children are as a rule affected when it has been taken by the mother. By the addition of equal parts of tallow or lard it loses its offensiveness in a great measure, and can be used as a base for ointments or pomades for the prevention or cure of *alopecia*. It is also combined with bay rum or alcohol for the same purposes, but there seems to be no good reason to believe that it has any special virtues in this direction. When added in the proportion of about 2 per cent. to collodion it renders it flexible and non-contractile when dry.

Russell H. Nevins.

CATAPHORESIS. — See under ELECTRICITY and cf. COCA AND COCAINE.

CATAPLASMS.—See POULTICES.

CATECHU.—This drug is an astringent, in consequence of the action of the catechutannic acid that it contains. It combines with albumin, forming a more or less dense pellicle on a surface denuded of epithelium, and it decreases mucous secretion. Mr. H. Addison considered that the catechuic acid was a nerve tonic.

In *hæmatemesis, sore throat, hoarseness, relaxation of the uvula, tickling cough,* and *faucial irritation* catechu in the form of lozenges will be found useful. In *ptyalism, gingivitis,* and *aphthæ* an infusion or the tincture is a mouth wash that will often be of great service. Either of these preparations is beneficial in *hypertrophy of the tonsils.* It has been used as an application to relieve *epistaxis,* as a wash for *sore* and *chapped nipples,* and as an injection in *gonorrhœa, gleet,* and *leucorrhœa.* As an astringent, it is much less powerful than the mineral astringents that have largely supplanted it as therapeutic agents. The dose is from 10 to 30 grains. The dose of the *infusum catechu* of the Br. Ph. is from 1 to 2 fl. oz. The dose of the *tinctura catechu* (Br. Ph., Ger. Ph.) is from ½ to 2 fl. drachms. The *tinctura catechu composita* of the U. S. Ph. is practically the same as the tincture of the Br. and Ger. Ph's. The *pulvis catechu compositus* of the Br. Ph. consists of 4 parts of catechu, 2 parts each of kino and rhatany, and 1 part each of cinnamon and nutmeg; the dose is from 20 to 40 grains. The *trochisci catechu* of the U. S. and Br. Ph's are of about the same strength; the dose is from 1 to 6 lozenges.

SAMUEL T. ARMSTRONG.

CATHARTICS, or *purgatives,* are agents which promote evacuations from the bowels. As compared with the physiological condition, the discharges thus produced are more copious and more fluid. The method or methods by which purgatives act has been the subject of considerable experimentation and more discussion. Though the relative importance of the parts played in the action of cathartics, a more energetic peristalsis, and an increase of intestinal secretion can not in the case of each drug or agent be definitely and accurately determined, it sometimes may approximately. It has been thought by some that the former of these is the one to which cathartics owe their power, and the explanation of this theory lies in the supposition that by a more rapid peristalsis the contents of the small intestine, which it is well known are fluid, are hurried along the intestinal tube without the normal delay in the large intestine during which the fluid fæces received from above are deprived of the greater part of their water and made solid. Doubtless some of the purgatives do act thus and are productive of little real increase of intestinal secretion, notwithstanding the fluidity of the movements gives rise to the appearance of such an increase. Because the peristaltic theory is correct, however, it does not follow that the theory of increased secretion is false. As a matter of fact, the latter is undoubtedly true, and equally without doubt it is the more important of the two. Many facts support this: the increased secretion in an isolated knuckle of intestine caused by cathartics, the fact that some drugs act to purge when absorbed by the blood and eliminated by the intestines, the fact that some drugs cause the discharge of fluid from the bowels in such enormous quantities as to imperil life, the fact that in the movements caused by some cathartics large amounts of sodium salts are found which are prominent constituents of serum, and the fact that salines so decidedly relieve portal congestion — all these considerations Wood presents in support of this belief, and his argument seems unanswerable. Both these explanations of purgative action are therefore apparently correct, though the share that peristalsis has in it is probably of the lesser importance. No purgative drug apparently owes its power to either of these actions exclusively, and, though they both take part to some extent in the case of each drug, yet the one or the other may predominate, and this has led Edes to ascribe the power of mechanical cathartics, resins, glucosides, and oils to heightened peristalsis, and that of salines, organic acids, and perhaps mercurials to increased secretion.

Another factor, too, must be considered in dealing with the effects of cathartics, and that is their effect upon biliary secretion, for bile in the intestine, as is well known, stimulates peristalsis. If, then, a drug increases the flow of bile it will correspondingly influence peristalsis and hence promote purgation. The evidence as to what cathartics increase this flow and as to how great this increase may be is very contradictory, and the most that can safely be said is that the more violent purgatives seem to cause increased biliary discharge from the bile ducts and from the intestine by stimulation of biliary and intestinal peristalsis, and that some few drugs seem to have a special ability to promote the biliary production. Of these last, the most prominent purgatives are aloes and podophyllum, though the experiments of Rutherford upon dogs are often quoted as a warrant for attributing this power to many another drug.

It is probable that many of the cathartic agents have particular portions of the intestines on which their actions are most energetic, an example of which is to be seen in the special activity of aloes upon the colon, and yet no territorial power can be even approximately assigned to most of them, for the actual application of a remedy to one part of the intestinal tube will often result in activity of a far-distant portion. The power of laxative enemata to cause peristalsis far above the rectum proves this.

The most rational classification of cathartics is one which is based upon their therapeutic activity, and, though the medical man has a pretty definite impression as to the potency of the drugs he so often uses, so that it matters little to him what class nomenclature the various writers adopt, yet unnecessary confusion

has resulted from the number of classifications proposed and the apparent willingness of authors to multiply names. Such terms as saline cathartics and mercurial cathartics are really serviceable, because, while in no sense suggestive of therapeutic action, they are unmistakably descriptive and, moreover, sanctioned and recognised by years of use. Some writers, indeed, appear to be influenced by this very unnecessary minuteness of classification and, going to the other extreme, make no division whatever, but describe the cathartic drugs in order, from the mildest to the most violent. Some classification, however, seems important, though it must be remembered that the use of greater or lesser doses may easily transfer a drug from one class to another, and that here as in most things medical sharp demarcation is the exception and "overlapping" the rule. "The simplest is always the best," and the simplest classification is that of Wood, who divides the cathartic group into laxatives, purges, hydragogues, and drastics.

Laxatives are the mildest of cathartics, and should cause gentle evacuation without irritation. The class includes many things not ordinarily classed as drugs, and among the foods we find many which have unmistakably a laxative effect. Of these are green vegetables, many of the fruits both fresh and dried, figs, prunes, and dates in particular, oils, honey, molasses, eggs, soups, Indian meal (maize), cracked wheat, oatmeal, bran, and bread made from unbolted flour or the coarser forms of grain. Some few of these are possessed of a drug value as laxatives, but by far the larger number of them cause evacuations for reasons which are purely mechanical, since any food which leaves a large percentage of indigestible or undigested residue will be sufficiently irritating to cause heightened intestinal activity. Certain beverages, too, have a laxative effect, especially malt liquors, and in suitable cases the administration of beer or ale will produce an excellent result. The cup of coffee so generally the accompaniment of a breakfast, beyond a doubt exerts a laxative effect, as may readily be ascertained by withholding it for a few mornings, and even tea, if properly prepared, and not the strong infusion or even decoction of tannic acid that it so commonly is, may have a similar effect. Water is a more valuable laxative than is generally appreciated, and not a little of the constipation which is so prevalent, especially among women, might be lessened or removed if more water were drank. In the milder grades of constipation a most satisfactory result will often follow the administration of a tumblerful of water upon rising in the morning and before breakfast. The efficiency of this treatment some think is greater if the water is taken cold, while others think its action more physiological if it is used hot. In either case, however, it is mildly effective, and this not because it is hot or because it is cold, but because it is water. Exercise is both directly and indirectly laxative in a marked degree; directly because of its stimulating effect upon digestive activity, especially that of the liver, and indirectly because of its strengthening and invigorating action upon the body generally. That exercise is so important in maintaining intestinal regularity is beyond doubt, and needs no more striking proof than is seen in the constipation of those who lead sedentary lives. Abdominal massage, too, is laxative and, though not extensively practised as yet, is a valuable therapeutic agent and one which deserves greater employment. Abdominal faradization is effective in the same way, though to a lesser degree. These are the non-medicinal laxatives, and, though I shall hereafter have occasion to refer to their employment in disease, it may be said here that *habitual constipation* is the condition in which their application is so valuable, and one, too, which should be corrected if possible by them alone.

Of medicinal laxatives there are a number, and many drugs possess laxative properties which, though marked, are yet subordinate to other and more important virtues. The laxative drugs in general use are tamarinds, manna, ox gall, cassia fistula, euonymus, cascara sagrada, light and heavy magnesia, viola tricolor, and sulphur. Olive oil, cottonseed oil, and cod-liver oil—in fact, bland oils in general—are laxative to a considerable degree, and rich cream has a similar action which renders it an excellent remedy for the *constipation of young children.*

With **purges** the action is more violent, but, though they produce marked intestinal activity and a considerable amount of irritation, yet this is not in itself sufficient to cause danger. Some members of this group might properly be placed in the group preceding this, and some, too, in that which follows. For them the question of classification would be determined simply by the amount of the dose, and, as has already been said, no hard-and-fast line of demarcation between the divisions of cathartics is possible. Those drugs which are most frequently used as purges, however, are castor oil, the mercurials (calomel and blue mass), rhubarb, aloes, senna, the saline cathartics, juglans, cascara sagrada, leptandra, and frangula.

Compound cathartic pills, *pilulæ catharticæ compositæ* (U. S. Ph.), should also be placed among the purges, though the effect will vary with the number taken, one serving for a laxative effect, while three, and even two, will be energetically purgative. Each pill contains $1\frac{1}{3}$ grain of compound extract of colocynth, 1 grain of calomel, $\frac{1}{4}$ of a grain of gamboge, and $\frac{1}{2}$ a grain of extract of jalap. A modification of these pills is found in the vegetable cathartic pills, *pilulæ catharticæ vegetabiles* (U. S. Ph.), which are preferred by some on account of their containing no mercurial. They contain compound extract of colocynth, extract of hyoscyamus, extract of jalap, extract of leptandra, resin of podophyllum, and oil of peppermint.

Hydragogues are cathartics whose action results in an abundant discharge of water from the intestine. The class is composite and contains members of the preceding group as well as many of the drastics. It will, therefore, be

apparent why the hydragogues are usually of considerable violence of action and also why in overdoses some of them may easily become drastic. The hydragogue drugs are: The mercurials, gamboge, elaterium, elaterin, and croton oil; the saline cathartics, magnesium sulphate, sodium sulphate, magnesium citrate, sodium phosphate, potassium tartrate, potassium bitartrate, and potassium and sodium tartrate: and the popular remedies, Carlsbad salts and saline mineral waters.

The drastic cathartics are those whose action is so violent and accompanied by so much intestinal irritation that the danger of pathological over-effect is great, and irritant poisoning is the result of overdoses. From their very irritant properties most of them are hydragogue, though only those commonly used for this purpose have been placed in the hydragogue group. The drastic cathartics are jalap, bryony, podophyllum, chelidonium, iris, euonymus, scammony, colocynth, gamboge, croton oil, elaterium, and elaterin.

The effects which cathartics have on portions of the body other than the intestinal tract are interesting and often important. On the kidneys the action of cathartic drugs is generally manifested by a diminution of the production of urine, and this is in proportion to the amount of fluid discharged from the bowels. The effect of hydragogues is, therefore, to cause great diminution of the urine unless it has previously been diminished by renal congestion, in which case the relief of the congestion by free and watery evacuations from the bowels may be the immediate predecessor of a greatly increased urinary flow. The saline cathartics are thought to increase the quantity of urinary solids, as well as in some cases to cause urinary alkalinity, and if no catharsis results from giving them, their energy is transferred to the kidneys and diuresis occurs. Another secretion which is somewhat affected by cathartics is the milk, but the purgative effect upon sucklings when cathartics have been administered to the mother seem to have been overestimated, for Gow's experiments, though not numerous either in cases or in drugs, apparently show that magnesium sulphate indeed frequently does have this effect, while senna, cascara sagrada, and aloes do not. The quantitative effect of purgatives upon the milk is perhaps of even greater importance than the qualitative, and castor oil undoubtedly has galactagogue powers, while the salines are thought to be equally active in diminishing the secretion. The yellow discoloration of the milk, as well as of the urine, resulting from the administration of rhubarb is well known.

There is considerable evidence to prove that certain of the purgative drugs may be effective when introduced into the body by channels other than the alimentary tract, and Gerhard has shown that purging may follow the application of powdered aloes to blistered surfaces. Such methods of administration, however, have no practical value, and, with the exception of purgative enemata and suppositories, cathartic agents are invariably administered by the mouth.

Purgative enemata are employed in cases in which, from gastric or intestinal inflammation, the internal administration of cathartics is unwise or inadmissible, in cases where the object is to accelerate or increase the activity of other cathartics, and in cases where fæcal overloading of the colon is to be relieved. Their action is mainly due to the stimulation of peristalsis which follows the irritation they produce—a peristalsis which, as we have already seen, is not confined to the area of application. The simplest form of purgative enema, but one which is efficient only where nothing beyond a mild action is required, is the injection of warm or cold water. Enemata of sweet oil, flaxseed tea, infusion of slippery elm, and demulcent infusions in general are also valuable. More active than these and more generally employed is the soapsuds enema, and the energy of its action may be enhanced by the addition of castor oil, magnesium sulphate, oil of turpentine, or glycerin. Pure glycerin may be injected in small quantities for the same purpose, and the recent introduction of glycerin suppositories affords another and most convenient method of its administration. The soap suppository, too, will often be valuable in causing catharsis, and its employment for children is especially to be recommended.

The relief of *constipation* is the most prominent if not the most important therapeutic application of cathartics, and, though for the correction of occasional constipation there is no objection to a dose of compound licorice powder now and then, or the infrequent half-bottle of solution of "citrate of magnesia," the extent to which popular self-purgation has gone is alarming. It is the daily experience of every practitioner to find persons who stupidly or wilfully neglect every natural and hygienic provision for maintaining regularity of the bowels, who utterly avoid exercise, whose diet is destitute of almost everything laxative, with whom tea is the only beverage, and who to counteract the intestinal sluggishness which not unnaturally results become veritable victims of the "liver pill" and its kindred. And so they continue year after year, constantly falling more and more under the control of the "pill habit," until finally only the stronger purges in any way affect them, and they constantly suffer from symptoms due to chronic constipation and fæcal accumulation. And yet they wonder all the time why they should "be so constipated and feel so badly." The continued use of cathartics, even the mildest, is the worst possible treatment of these cases of continued constipation, and, though it may be occasionally necessary to supplement the other and more proper remedies by a laxative "prod," this must be as infrequent as possible and the agent most mild. The rational treatment of *habitual constipation* is by the observance of hygienic rules in general, and especially those which govern diet, exercise, and habits of regularity. Many a person is constipated because he has no regular hour for defecation, but attends to the matter when he "finds time"; and many, too, suppress the inclination to defecate because they have something else they

want to do, and yet when they do find leisure for the purpose are surprised to find that the bowels will not move. The sole treatment necessary in such cases is for the patient to have a fixed time for defecation each day and at that time to devote himself to this object. At first the establishing of this regular habit may be difficult, but if the regularity is persisted in the bowels will soon respond with a like regularity, for indeed they seem creatures of habit almost as much as man himself. For the constipation of those who lead sedentary lives exercise is the specific, and for those whose diet is constipating the laxative foods must be prescribed. Water drinking will often correct mild grades of constipation. It has already been considered. In some cases the relinquishing of the tea habit will be required or that of the astringent wines; and for them may be substituted (if nothing forbids) an occasional glass of beer or ale. If these remedies are not enough, the cold enema may be employed, or abdominal massage, or faradization, and certainly their use is wiser than that of the ever-ready pill. In some cases these means will be sufficient, but in others it will be necessary to add to them the correction of certain functional irregularities before a cure or even relief will result. Thus, the constipation which accompanies gastric dyspepsia can not be radically cured until the dyspepsia is treated and relieved. In like manner, the constipation of anæmia or debility can be permanently removed only upon the correction of these conditions. In the constipation due to functional disturbance of the liver and an insufficient production of bile, those cases so often described as "bilious," the drugs which are supposed to stimulate hepatic action must be given at first, and especially ipecac, nitrohydrochloric acid, magnesium sulphate, podophyllum, and bichloride of mercury. If, notwithstanding these means, the digestion becomes disturbed, the tongue is furred, and all the signs of a "bilious" attack are present, nothing so well suffices as a free mercurial purgation. The use of these drugs must not be persisted in, however, lest dependence on them should result, and indeed it is not necessary that it should if other means are applied to the case, and above all things if exercise is used freely.

Cases of *fæcal accumulation* in the colon, especially common in the aged, are indeed difficult to cure, for here it is no functional disturbance to be set right, but a defective innervation and an exhausted and atrophic condition of the intestinal muscles. Aloes is the remedy most valuable for this condition, and it is generally combined with strychnine that the tonic effect of the latter drug may be had so far as possible for the debilitated muscles and impotent nerves. Even with this treatment accumulation often takes place, and then is required the enema, and even the manual removal of scybala. These are the causes of constipation we are oftenest called upon to remove; of less frequent causes, such as chronic lead poisoning, it is not necessary to speak. The correction of the constipation which accompanies acute febrile diseases requires no consideration further than that already given, for from its very nature it is limited in duration, and the employment of laxatives and even purges for its correction is therefore justified.

To check the *diarrhœa due to undigested food* by removing from the intestines those irritating and generally decomposed matters on which the discharge depends is another and most important application of the purgative drugs. For this purpose castor oil is generally most efficient or, if that is objected to, a saline. The use of cathartics for the relief of *intestinal colic* is similarly explained and the drugs used are the same.

Elimination of morbid materials and poisons from the body is another service rendered by cathartics, and especially in the condition of *uræmia* their value is exceedingly great. The hydragogue drugs are generally the ones employed for this purpose, and particularly elaterium. In using these active remedies it must not be forgotten that, employed too often or for too long a time, they may be productive of considerable debility, and this in a disease in which debility is one of the greatest dangers. The removal of the poisons of *gout* and *rheumatism* from the body may perhaps be accomplished to some extent by the salines, and the antidotal effect of the sulphates of magnesium and of sodium in *poisoning by lead* and *carbolic acid* is well known. That the poisons of infectious diseases are removed by purgation is more than doubtful, and the benefit derived from beginning the treatment of such diseases by a free catharsis is probably more imaginary than real.

Some of the cathartics, and especially the salines, act to deplete the digestive tract and the body generally, and thus remote inflammatory conditions may be much benefited as well as those of the intestines themselves. *Dysentery* is thus treated by the administration of a saline, given either in one large dose at the invasion of the disease or in small and frequently repeated doses throughout its course. *Portal congestion* is benefited in the same way, and indeed the good effect of a course of treatment by Carlsbad salts in *hepatic cirrhosis* is often most striking.

The hydragogue cathartics are much employed in aiding the absorption of *dropsical effusions* by causing the discharge of large quantities of fluid from the bowels. Their power to accomplish this is great, but care must be exercised lest their continued use result in injurious and even dangerous exhaustion. *Inflammatory effusions*, too, are sometimes thus treated in the chronic stage; an example of this is offered by *pleurisy with effusion.*

In conditions associated with *cerebral congestion* the use of the hydragogues as revulsives is often of great benefit, but it is more than likely that depletion is as much to be credited for this as revulsion is.

The pelvic circulation is decidedly stimulated by a few of the cathartics, especially aloes. In *atonic uterine conditions*, therefore, this drug has met with considerable employ-

ment, and is especially used in combination with iron and with myrrh.

The contra-indications to the use of cathartic drugs have to some extent been suggested in what has preceded, but in general it may be said that they are as few as the indications are many. The most important ones are the danger of doing permanent harm by giving rise to the continued necessity for their use, and the presence of gastric or intestinal ulceration and severe inflammation, as well as the occurrence of organic intestinal obstruction. In pregnancy and during menstruation, too, the use of all save the mildest of cathartics is forbidden, and at these times aloes seems especially apt to be harmful because of its exciting effect upon the pelvic circulation. Finally, the effect of some of the laxatives upon the milk must not be forgotten when they are administered to women in lactation.

In giving the cathartic drugs a greater effect will invariably follow their administration upon an empty stomach, and to enhance their action the drinking of water in considerable quantity, as well as the taking of moderate exercise, will be efficient. The salines may be given in carbonic-acid water, but the advantage this possesses over ordinary drinking water is not great. One peculiarity of the action of salines is, however, to be noted, for it intimately concerns their administration, and that is the degree of concentration in which their solutions should be administered. It has been ascertained that the strength of a saline cathartic solution in the intestines an hour or two after giving it is in the neighbourhood of 6 per cent., any amount of water with which it has been given, more than enough to make a solution of this strength, having been absorbed, while any deficiency of this fluid of administration has been supplied by the intestines until the proper dilution has occurred and the required percentage has been attained. It apparently follows, therefore, that to produce the greatest depletion a solution stronger than 6 per cent. should be given, while to obtain the greatest rapidity of action the solution as administered should be one of about this percentage.

A tendency to cause griping is a marked characteristic of the more energetic cathartics, and to counteract this, especially in the case of vegetable cathartics, the aromatics, opium, and belladonna are used.

HENRY A. GRIFFIN.

CATHARTINIC ACID, $C_{180}H_{96}N_2SO_{82}$, a brownish-yellow powder obtained from senna leaves, is said to be a trustworthy and energetic cathartic, and to be free from disagreeable taste. The dose for an adult is $2\frac{1}{2}$ grains; for a child from two to four years old, $\frac{3}{4}$ of a grain. The remedy has been found very useful in *habitual constipation.*

CATHERETICS are agents whose action is mildly caustic. In this country the name is seldom used, and the group for which it stands is rarely set apart from the caustic class. As a matter of fact, it is scarcely necessary that such a subdivision should be made, for we gain nothing by calling a mild caustic a catheretic, and on the other hand there is the very valid objection to it that it introduces another name and another class into a branch of medical science which is already overendowed with them. In one sense the name has an apology for its continued existence, for the common use made of mild caustics is in the removal of small growths, and hence the practical application of the word catheretics is to drugs generally employed for the destruction of *corns, warts, redundant granulations,* and *morbid vegetations.* The more active caustics will of course destroy such tissues promptly, but it is to the feebler ones, which act rather by a slow eating away, that the name catheretics is applied. Of such agents there are a number.

Acetic acid and its modifications offer the best example of catheretic drugs, and the frequently repeated application of the official acetic acid or of glacial acetic acid to small growths is most effective. This end is also well accomplished by salicylic acid, and therefore the combination of these two drugs as recommended by Unna is an excellent one. His formula is:

℞ Salicylic acid......... 30 grains;
Acetic acid........... 1 oz.
M. S.: Apply with a camel's-hair brush.

The particular use he makes of it is for *condylomata.* Monochloracetic acid and trichloracetic acid are likewise active, and the frequent application of either to *warts, condylomata, indolent ulcers,* and *nævi* will generally result in a satisfactory destruction and a healing accompanied by little or no scarring. Moreover, the applications are practically painless, and therefore especially suitable for use on children.

The action of salicylic acid in destroying small growths has already been mentioned. It may be applied in powder and bound on or in any solution, but collodion seems to be the best vehicle. The formula of a very widely used *corn cure* is as follows:

℞ Salicylic acid,
Tincture of cannabis indica, each.............. 1 drachm;
Flexible collodion, enough to make................ 1 oz.
M. S.: Apply with a camel's-hair brush morning and night, limiting the coating strictly to the corn. The applications are continued for several days, and then the parts are soaked in warm water, when the corn may easily be shelled out in part if not entirely.

Copper sulphate, zinc sulphate, and silver nitrate are valuable caustics, but their action is as a rule mild and the effect produced is superficial. As caustics they are applied in solid form. Dried alum, too, is feebly escharotic, and is efficient in destroying *flabby* and *unhealthy granulations.* The use of potassium bichromate in solution is often advisable for the destruction of *small growths, venereal excrescences,* and *mucous patches.*

In former times the word catheretic had another meaning, and in old works on medi-

cine we find it applied to the use of evacuants for causing the removal of swellings, effusions, and enlargements by the production of great debility.—Henry A. Griffin.

CATRAMINE, said to be a volatile oil derived from *Abies canadensis balsamica*, has been recommended as superior to oil of turpentine as a stimulant, expectorant, and diuretic, also, used subcutaneously, as a remedy for *tuberculosis* and *lupus*. Adequate data are not at hand to warrant its use in preference over better-known drugs at present.

CAULOPHYLLUM, blue cohosh, the root of *Caulophyllum thalictroides*, though its name still lingers in the U. S. Ph., is practically not in use among physicians.

CAUSTICS.—While there may be a verbal distinction between these bodies and *cauterants*, there is little or no practical difference between them, as the action of the two is essentially the same. They are usually divided into two classes, the *actual*, or those in which heat, no matter how employed, is the active agent, and the *potential*, by which a chemical process of deoxidation, abstraction of fluid, coagulation of albuminoids, or conversion of the tissues into carbon or gaseous bodies is called into play. The action of both classes is more or less painful, that of the actual cautery being the severest at the moment but of slight duration, while that of the caustic alkalies is probably less painful than that of the other potential cauteries. When destruction of tissue is the object the pain may be avoided by the aid of anæsthetics or anodyne medicines save when the discomfort attendant upon their use will probably be greater than that caused by the caustic, but when counter-irritation or a revulsive effect is intended they are inadmissible, as the pain inflicted by whatever agent is used enters largely into the curative action of this procedure. Apart from questions of convenience and ease, it is of little moment whether the galvano-cautery, the so-called thermo-cautery, or the old-fashioned cautery iron is used, as the therapeutic effect in each case is the same. When attainable, the galvano-cautery or a platinum wire or instrument heated by an electric current passed through it presents the great advantages of being perfectly under control, so far as temperature is concerned, and of its capability of being made in almost any desired form. The thermo-cautery (Paquelin's cautery), or a platinum point heated by the vapour of gasoline or by illuminating gas, stands next in convenience, but is not very safe, when gasoline is employed, to use in the vicinity of light and in operations near the face, for it may ignite the vapour of the anæsthetic used or any inflammable liquid which may be carelessly spilled. It is also somewhat freaky, working well at one time and cooling without any apparent reason at another. Irons heated by the direct action of fire or flame are rarely used at the present time save when the other more convenient appliances are not at hand or when the cauterization is to be so slight as to hardly warrant the trouble of putting them in operation. Those made of steel or iron are the best, as they are less liable to become rough, and also retain their heat better than those of other metals. They should, if possible, be heated by a charcoal fire, one of coal being more apt to roughen them, by a Bunsen burner, or a specially constructed alcohol lamp. If it is at hand, the small lamp, burning gasoline or the like under pressure, used by plumbers to melt lead and solder will be found to give an intense heat. For the destruction of *warts*, *moles*, and other very *superficial growths*, the rays of the sun brought to a focus by a biconvex lens on the part to be operated upon will often give good results, and if care is taken to affect only the superficial layers of the skin, the eschar is scarcely perceptible. This procedure, however, is quite painful and slow. The surfaces of all kinds of cautery irons which come in contact with the tissues should be as smooth as possible, for rough and corroded spots are apt to adhere and tear the part.

Their temperature must depend upon the effect desired. When destruction *en masse* is sought for, and there is no danger of or objection to a slight trespassing upon the adjoining tissues, the higher the temperature, within reasonable limits, the better. as when it is sufficiently high there is actual combustion, a conversion of the tissues into gaseous bodies, and little or no slough is formed beyond a thin layer upon the unaffected parts. Of course too high a temperature is to be avoided within the various cavities of the body or in the vicinity of delicate organs or important structures. When, on the other hand, counter-irritation or a revulsive action is desired the cautery should not be more than hot enough to be of a dull-red colour; also when used to arrest hæmorrhage it should be of about this temperature. Shields of various forms and materials have been devised to protect the sound tissues against the heat of cautery irons, but asbestos cardboard, to be found at all dealers in machinists' supplies, is as good as anything for the purpose and is inexpensive and clean. The form of cauteries is to be governed entirely by the uses they are to be put to, but as a rule the smaller they are the easier is their manipulation. When they are to be used for counter-irritation, a fine-pointed instrument is preferable, as it may be drawn lightly over the surface, making narrow, linear burns or small points, which should not be deep enough to cause anything more than the smallest amount of suppuration. Contact with or close approximation to bones must be avoided, otherwise caries or necrosis is extremely apt to follow.

In the treatment of *long-standing neuralgias*, especially of the larger nerve trunks, the actual cautery is often effectual when other and milder measures have failed. *Spinal irritation* may sometimes be severe enough to demand this procedure. In both conditions the probable occurrence of disfiguring scars must be borne in mind and parts subject to friction by the clothing avoided as far as possible. *Contracting cicatrices* in which nerve

filaments are included and compressed, causing often intolerable pain, are better treated with this than anything else, but to be effectual the cicatrix must be repeatedly cauterized until entire relief is experienced. In all neurotic conditions the moral effect of the actual cautery must not be lost sight of, as it is often most marked and the benefit obtained is entirely out of proportion to the extent of the cauterization.

The list of potential caustics which have been or are employed is almost endless, and the selection of the one to be used oftener depends upon the individual preferences of the operator than upon any real difference in effectiveness between them. On account of their strong affinity for water and their powerful coagulant effect upon albuminoids, the concentrated mineral acids naturally occupy the first place in conditions or situations in which their tendency to extend their action is not a drawback. Of this group, sulphuric and phosphoric acids are the most energetic, and, if used in considerable quantity, will penetrate and destroy the tissues to a very marked degree; consequently they are not often used. The former, however, when made into a pasty mass with dried zinc sulphate or with powdered asbestos in the proportion of 3 parts of the acid to 1 part of asbestos (the latter preparation being known as Michel's paste), becomes manageable and gives rise to a superficial and easily detached eschar. Hydrochloric acid is rather feeble, but is sometimes used to destroy *superficial cutaneous growths.* Chromic acid is a powerful escharotic, rarely if ever used in its crystalline form, aqueous solutions varying in strength according to their uses being preferable. They are used to destroy the smaller morbid growths, such as *warts, condylomata*, etc., especially when situated in the mouth, the larynx, or some other cavity of the body, but are to be employed with caution, as they are apt to penetrate deeply. Nitric acid is the most extensively used of these acids. The fuming variety is the most effective and for general purposes is probably the best, as the surfaces cauterized by it are left in a better condition to heal than when other agents are employed. *Condylomata, cancrum oris, warts, venereal ulcerations, phagedæna, internal hæmorrhoids*, and *non-malignant growths* in general are the morbid manifestations for which it is most commonly used.

Glacial acetic acid is somewhat escharotic, but is not much used except to destroy *warts* or *corns.* Crystalline carbolic acid or a strong solution of it is rarely used save in treating *venereal* or *shallow ulcers*, in which cases its germicidal properties are of advantage, and, moreover, it is slightly anæsthetic and the pain caused by it is not apt to last long. A mixture of 2 parts of the crystalline acid and 1 part of iodine, diluted as desired with glycerin (known as iodized phenol) and one of equal parts of the acid and of iodine in 150 of glycerin (denominated iodated phenol) have both been used with some success as intra-uterine escharotics. Whenever any escharotic preparation consisting of an acid or having a strongly acid reaction is used, it is wise, when practicable, to cover the surfaces which are to be unaffected with some unctuous body such as vaseline. The action in all cases may be checked by free irrigation with a weak solution of any alkali, except the carbonates, which by giving off carbonic-acid gas might give rise to complications. When caustic acids are used in or near the mouth great care should be observed to prevent their contact with the teeth, and after their employment the mouth must be washed out thoroughly with an alkaline solution.

A glass brush is the most convenient instrument for applying acids, but a glass rod, a rag on the end of a stick, or a stick itself may be used if the former is not at hand. Bromine is one of the most powerful caustics used in medicine, but its action is almost beyond control and its application to living tissues is followed by widespread destruction and ulcerating surfaces which are very slow to heal. It is consequently rarely used except in the treatment of *hospital gangrene.* Arsenic or arsenious acid has been used extensively for the destruction of malignant growths, especially *cancers*, and is the basis of many of the empirical preparations sold for that purpose, but it is not better than many other caustics, and unless employed with caution may be absorbed and give rise to arsenical poisoning. It causes great pain and is usually combined with not more than 4 parts of flour, starch, calomel, or some other inert substance, as mixtures of lesser strength do not excite sufficient inflammatory action to prevent its absorption. It must be applied to raw surfaces, and it is not best to cover at one time an area greater than that of a half-dollar. For the destruction of large masses of morbid growths, especially those of a malignant type, there is hardly any caustic so desirable as zinc chloride, which, though exciting considerable pain, is not absorbed or, if it is, is without any injurious effects upon the general system. It is usually combined with flour, equal parts of which and the zinc salt constitute Canquoin's paste, and is applied in cakes or plates upon a denuded surface. In from ten to fourteen days the eschar separates and a fresh surface is exposed, to which further applications may be made if necessary. By adding half as much antimony chloride as the amount of zinc chloride, a very energetic compound is formed.

Felix's caustic paste has this salt as a basis, and contains carbolic acid, croton chloral, brominated camphor, iodol, corrosive sublimate, and starch or flour, but it is no great improvement upon the simpler Canquoin's paste. Small cylinders formed of a mixture of zinc chloride and calcium sulphate, flour, or the like, re-enforced by threads in their interior or wound around them, are sometimes used to form issues or inserted into incisions surrounding a morbid growth with a view to causing a slough of the central mass by depriving it of nutriment.

Zinc sulphate may be used in the powdered form. It acts rapidly and quite powerfully, and is well adapted for destroying the surface

of unhealthy *ulcers*, etc. Combined with equal parts of corrosive sublimate, it has been employed with good results in *onychia maligna*, one application being usually sufficient to cause sloughing down to healthy tissue. Corrosive sublimate, or mercuric chloride, is possessed of decided escharotic properties, but is apt to be absorbed and is rarely used. A solution of mercuric nitrate (the *liquor hydrargyri nitratis* of the U. S. and Br. Ph's) is applicable in the treatment of *venereal ulcers*, *ulcerations of the cervix uteri*, *lupus*, and in general all *shallow ulcerations*, also to the removal of the cuticle preparatory to the use of other caustics. It may be applied with an ordinary camel's-hair pencil, but should not be allowed to remain on longer than necessary, lest absorption and salivation should occur. For all conditions in which a superficial action is desired silver nitrate is by far the best caustic we possess. Its action is limited to the parts with which it comes in contact, and it is extremely easy of application. The crystals are not often used, but generally small sticks or pencils, sometimes strengthened by threads in their interior or by wax, platinum wire, etc., upon their exterior where only small surfaces are to be touched or a sinus is to be treated. A small quantity can be melted in a porcelain dish, and probes given a thin coating by simply dipping them into it. For ordinary external use one of the numerous caustic holders furnishes a convenient method of holding it. When, as has sometimes been the case, fragments have been detached from the pencils, etc., any disastrous or undesirable effects may be prevented by the free use of solutions of common salt.

Caustic potash, or potassa, is powerfully escharotic, needing no preparatory denudation of the skin, and its action extends widely beyond the point of application; consequently it is not to be employed when a limited effect is called for. By itself it is rather more powerful than is usually desired, and it is commonly combined with equal parts of caustic lime, forming Vienna caustic or paste. When mixed with equal parts of gutta percha it becomes somewhat more manageable and less diffusible, and can be moulded into almost any desired shape. Before using this it must be soaked in alcohol for a few seconds. Potash itself and Vienna paste have been extensively employed in the treatment of *cancer*, to form issues, and to open *boils*, *carbuncles*, and *indolent* or *deep-seated abscesses*, but for the majority of these conditions the galvano-cautery is much to be preferred. When it is used to open boils, etc., a piece of adhesive plaster with an opening of the size of the part to be cauterized is placed upon the surface and the caustic applied over the uncovered portion. Caustic soda is less deliquescent and diffusible than potassa, and may be substituted for it; when combined with equal parts of caustic lime it is known as London paste. After the use of alkaline caustics, if it is desired to limit their action this may be done by irrigating the parts with weak acid solutions.

Copper sulphate, chloride, and nitrate are more or less caustic, but are rarely used as such. The question of poulticing after the use of caustics is one which must be determined by the situation, etc., of the cauterized parts. When a second cauterization is to be performed it is better to use them, or when superficial collections of pus are opened into, but when these collections are deep-seated and one object of using caustics is to form a fistulous tract with thick and tough walls, they should be avoided. If they are applied after the cauterization has been done for the purpose of revulsion or counter-irritation they defeat the end in view in a measure by relieving the irritation of the peripheral nerves.

For the removal of large and superficially located *tumours* the knife is by far the best means, and holds out the greatest hope of eradicating all malignant growths. On the other hand, when the parts are not readily accessible or the disease processes are superficial, the actual cautery is entirely satisfactory and in many cases the only suitable means. Probably nitric acid and zinc chloride are the safest and most generally applicable of the potential caustics where any decided action is desired, and silver nitrate is the best for superficial lesions. As a rule, it is better to destroy but a small amount of tissue at one time, and to repeat the operation as it may be needed. This is of special importance when caustics are used on parts where a permanent scar would be a disfigurement.—Russell H. Nevins.

CAVIARE, the salted roe of the sturgeon, has been used occasionally as a substitute for cod-liver oil. For those who find it palatable it is undoubtedly very nutritious.

CAYAPONINE, an alkaloid obtained from the fruit of a Brazilian species of *Cayaponia*, a cucurbitaceous plant, is said to resemble elaterin very closely in physical qualities and chemical composition. It has been used as a purgative in doses of about nine tenths of a grain, and is said to be efficient and not to produce griping.

CELANDINE.—See Chelidonium.

CELASTRINE.—The accounts of the alkaloid of this name obtained from *Celastrus edulis* are meagre and contradictory, but it seems that in almost every way except that of acting as an anæsthetic it resembles cocaine in its physiological effects. The same name has been given to a crystalline principle obtained from *Celastrus scandens*.

CELERY, *Apium graveolens*, is popularly reputed to have some medicinal virtue, and an American proprietary preparation called *celerina* is largely advertised as a nerve tonic. An analogous compound is the *elixir apii graveolentis compositum* of the N. F., consisting of 1 fl. oz. each of the fluid extracts of celery root, coca, kola, and viburnum prunifolium, 2 fl. oz. of alcohol, and enough aromatic elixir to make a pint. The dose is a teaspoonful.

CENTAUREA BENEDICTA, the *blessed thistle*, is official in the Ger. Ph. as *herba cardui benedicti*, and the official preparation is

extractum cardui benedicti. The leaves are tonic, and have been used in *intermittent fever.* The dose of the powder is from ½ to 1 drachm.

CENTAURIUM, *centaury*, the *herba centaurii* of the Ger. Ph., is a common European herb resembling gentian in its properties as a tonic.

CEPHAELIS.—See Ipecacuanha.

CEPHALANTHUS.—*Cephalanthus occidentalis, swamp-dogwood*, an American rubiaceous shrub, has been used as a medicine, but it is a potent poison and any real medicinal virtues it may possess it doubtless shares with other and less dangerous remedies. It contains a glucoside, *cephalanthin*, which in experiments on animals has been found to paralyze the heart and to disintegrate the blood-corpuscles.

CERA.—See Wax.

CERASUS.—See Laurocerasus.

CERATES, *cerata*, are a class of unctuous preparations that have for their base a mixture of wax and oil or lard. This admixture makes them harder than ointments, though they are softer than plasters; and they are easily spread on linen without requiring heating like a plaster; and when applied to the skin they do not melt as ointments do. They should be prepared by melting in a sterilized water bath, by carefully regulated heat, and then the mass should be thoroughly triturated in a sterilized mortar. The lard should be carefully selected to insure its freedom from rancidity, and all steps in the procedure should be followed with care to prevent contamination.

The cerates should be kept in a cool place, and it has been ascertained that those made with yellow wax are likely to keep better and longer than those made with white wax.

The *ceratum* of the U. S. Ph. consists of 3 parts of white wax and 7 of lard. It is used as a base for incorporating many medicinal substances. The simple cerate, *unguentum cereum*, of the Ger. Ph., is composed of 7 parts of olive oil and 3 of yellow wax.

Samuel T. Armstrong.

CEREBRINE.—This name has been given to a material prepared from brain substance. Its employment as a remedy is discussed in the article on Animal Extracts and Juices, in the section on *Nervous substance* (see page 80).

CEREUS GRANDIFLORUS, or *Cactus grandiflorus*, the *night-blooming cereus*, indigenous to tropical America, is said to contain an alkaloid, cactine, but Gordon Sharp (*Practitioner*, Sept., 1894) declares that he has been unable to find in it either a glucoside or an alkaloid, that its feeble action as a diuretic is probably due to the resins it contains, and that it has no other appreciable medicinal action. It has been reputed to be a cardiac tonic of similar action to that of digitalis, and has been recommended in *palpitation of the heart, aortic regurgitation*, and *angina pectoris*, also as a remedy for *rheumatism* and for *sexual exhaustion.* A tincture made with 5 parts of alcohol to 1 part of the drug may be given in doses of from 5 to 40 drops, three times a day. Cf. Cactine.

CEREVISIÆ FERMENTUM (Br. Ph.).—See Yeast.

CERIUM.—Though cerium nitrate has been used to some slight extent in medicine, it has seemed possessed of little therapeutic value and possesses no advantage over the oxalate save in a greater solubility. Its use at the present time is practically abandoned and the only salt of cerium used medicinally is the oxalate.

Cerium oxalate, cerous oxalate, *cerii oxalas* (U. S. Ph., Br. Ph.), ($Ce_2(C_2O_4)_3 + 9H_2O$), is a white, granular powder, without odour or taste, permanent in the air, insoluble in water, in alcohol, in ether, or in solutions of potassium or sodium hydrate, but soluble in diluted sulphuric or hydrochloric acid.

Cerium oxalate bears a considerable resemblance to bismuth subnitrate in its physical and chemical properties as well as in its therapeutical employment. Its application in disease is practically to the same class of disturbances as that of bismuth, but its field is more limited, since, though it is used for other conditions, its value is seen mainly in gastric troubles.

The administration of cerium oxalate in cases of *chorea* and *epilepsy* has been thought valuable by some, but their opinion has not been shared by the profession at large, and such application of cerium is now rare.

The resemblance of cerium oxalate to bismuth subnitrate has led to its employment in *diarrhœal conditions*, in which bismuth is so useful, and especially in *chronic diarrhœa.* The results of this employment of it are in no way to be compared with those obtained from bismuth, and cerium is now seldom employed for this purpose.

Cerium oxalate has been thought valuable in several varieties of *cough.* The excessive coughing of phthisis or of chronic bronchitis is occasionally benefited by its use, but the form most relieved by it is that dependent upon gastric disturbance and sometimes associated with vomiting.

The pain of *gastralgia* is at times relieved by the administration of cerium oxalate, but it is not to be depended upon for this action, and the chief therapeutical use of it is to control *vomiting.* For this condition it is, if morphine is excepted, about as valuable an antemetic as we possess. It is not invariable in its action, and indeed the unreliability of antemetics is well known, but it is rather more trustworthy than others of its class, and its failure to act may not seldom be accounted for by its being given in insufficient doses. A failure of immediate result is, however, not unusual, and it sometimes shows its effectiveness only after it has been administered for several days.

It has been thought that the *vomiting due to pregnancy* or to *uterine disease*, and hence reflex in its origin, was more benefited by cerium than other forms of vomiting. This reflex vomiting is indeed often thus relieved, but no

less is the vomiting due to inflammation or organic disease of the stomach or to dyspepsia, also that of purely nervous origin.

Cerium oxalate may be given suspended in a mixture, but more satisfactorily in pill or powder, and in doses of from 1 to 8 grains three or four times a day. The most effective method of administration, however, as well as the most convenient, is to add 5 grains of cerium oxalate and 10 grains of sodium bicarbonate to a glass of cold milk, which is then administered to the patient in doses of 1 drachm, at first at intervals of half an hour, subsequently, as nausea and vomiting grow less, at shorter intervals and in larger quantity. The good results of this method are often most striking. (See ANTEMETICS.)

HENRY A. GRIFFIN.

CERUSSA.—Basic lead carbonate (see under LEAD).

CETACEUM.—See SPERMACETI.

CETRARIA (U. S. Ph., Br. Ph.), *lichen islandicus* (Ger. Ph.), or *Iceland moss*, is the dried lichen *Cetraria islandica*, or *Lichen atlanticus*, a moss found in the elevated regions of the Northern Hemisphere. It is inodorous, has a bitter taste, and absorbs more than its own bulk of water. When macerated in a very weak solution of an alkaline carbonate it loses its bitterness and assumes a gelatinous consistence and is sometimes substituted for acacia and other gums, but is destitute of medicinal properties. It consists principally of gum and a peculiar starch, *lichenin*, and a bitter principle, *cetrarin*. It is used largely as a food by the inhabitants of many of the countries in which it is found, but is of no great value as such. Being demulcent, tonic, and non-constipating, it has been used largely in the past in the treatment of affections of the mucous membranes. Its decoction, the *decoctum cetrariæ* of the Br. and U. S. Ph's, contains about 5 per cent. of the moss and constitutes a more or less desirable vehicle for remedies employed in the treatment of *pulmonary diseases* and *diarrhœa*. Cetrarin is a useful tonic in cases in which there is *constipation*, and may be given in doses as large as 3 grains three times daily. The moss itself, deprived of its bitter taste, is sometimes used to make jellies, 1 part being boiled in 300 parts of water and reduced to the desired consistence, but it is by no means so good as the carragheen, or Irish moss.

RUSSELL H. NEVINS.

CEVADILLA.—See SABADILLA.

CHALK.—Crude chalk, the *creta* of the Br. Ph., is used for the production of carbonic-acid gas. Prepared chalk, the *creta præparata* of the U. S. and Br. Ph's, is chalk freed from most of its impurities by elutriation and dried in small masses; a purer product, the *calcium carbonicum præcipitatum* of the Ger. Ph., is prepared by precipitation. In one or the other of these prepared forms chalk is used in medicine, although that prepared from oyster shells, coral, astacoliths, crabs' claws, etc., is to be preferred on account of greater mildness and less irritating properties. As a dusting powder it is used in cases of *chafing*, *abrasions*, *ulcers*, *eczema*, and *intertrigo*, and to protect the skin of the perinæum and buttocks of infants from the irritation of the urine, also in *burns*, *scalds*, and all similar superficial solutions of continuity of the skin. In poisoning by acids it is a chemical antidote and the one as a rule most easily obtained in emergencies, and common chalk answers as well as the official. Mixed with equal parts of lard, it has been recommended as an application in *erysipelas*, but has not proved very useful. It forms the base of nearly all dentifrices, the best forms consisting of the chalk simply flavoured with orris root or tincture of myrrh. Its principal uses internally are in the treatment of all forms of *diarrhœa*, more particularly those in which there is acid fermentation and in that occurring in strumous children, in which it has not only an astringent effect, but the specific action that all the salts of calcium have in such conditions, and in the early stages of *cholera infantum* it is probably the best remedy. It also has antacid properties and is applicable in *pyrosis* and *acid eructations* from the stomach. For diarrhœa it is best administered in the shape of the compound chalk mixture in tablespoonful doses, to which may be added any astringent, the one most commonly used being catechu, or, if it is specially indicated, opium.

The compound chalk powder, *pulvis cretæ compositus*, of the U. S. Ph. contains 30 parts of chalk, 20 of gum acacia, and 50 of sugar; to 20 parts of this 40 of cinnamon water and 100 of plain water are added to make the chalk mixture, *mistura cretæ* (U. S. Ph., Br. Ph.). The powder may be kept for a long time in well-stoppered bottles and in a cold place, but the mixture must be made when called for, as it becomes sour quite rapidly in warm weather. Troches, *trochisci cretæ* (U. S. Ph.), containing about 4 grains each of chalk, with the addition of a small amount of spirit of nutmeg, offer a very easy method of preparing an extemporaneous chalk mixture. Rubbed up with metallic mercury it constitutes mercury and chalk. The aromatic powder of chalk, *pulvis cretæ aromaticus* (Br. Ph.), contains about 1 part of chalk in 5; the addition of 1 part of opium to 39 of this powder forms the aromatic powder of chalk and opium, *pulvis cretæ aromaticus cum opio* (Br. Ph.), of which from 10 to 40 grains is the dose.

RUSSELL H. NEVINS.

CHALYBEATES.—See IRON.

CHAMOMILE. — This name has been rather carelessly applied to several plants, but properly belongs to *Anthemis nobilis*, a native of Europe, but cultivated extensively in this country. This is also referred to as true chamomile, Roman chamomile, English chamomile, Scotch chamomile, and white chamomile, and is the *anthemis* of the U. S. Ph., the *anthemidis flores* of the Br. Ph. The name "chamomile" is also given to *Matricaria Chamomilla*, but properly this is known as German chamomile; it is official as *matricaria*

in the U. S. Ph. and as *flores chamomillæ* in the Ger. Ph. German chamomile is comparatively little employed in the United States, the "chamomile" generally used here being anthemis.

In composition anthemis and matricaria differ but slightly, containing volatile oils of marked similarity, bitter principles, and small amounts of tannin. To the presence of these oils is attributed the larger part of the therapeutic activity possessed by these drugs. An *anthemic acid* has been described as occurring in anthemis, and to it is attributed the bitter aromatic taste of that drug. No alkaloid has been found either in anthemis or in matricaria.

So closely do the two drugs, anthemis and matricaria, resemble one another that confusion has arisen, not only as regards the application of the word "chamomile" to them, but also as regards their preparations. Thus, there have been used *decoctio chamomillæ*, *oleum chamomillæ*, *extractum chamomillæ*, *extractum chamomillæ fluidum*, *infusum chamomillæ*, and *tinctura chamomillæ*; and, though the word *romana* has been added to signify anthemis, and *vulgaris* to denote matricaria, this addition has not been sufficiently regular or sufficiently distinctive to prevent confusion. Most of these preparations are no longer used in the United States. The dose of powdered anthemis is from ½ to 1 drachm. In this country the unofficial oil of anthemis (*oleum anthemidis*) is sometimes given in doses of from 5 to 15 minims, but the preparation by far the most commonly used is an infusion of anthemis (*infusum anthemidis*). Less often there is employed an infusion of matricaria. The infusion of anthemis is usually made in the proportion of ½ oz. to the pint, and of this the dose for stomachic effect is from 1 to 2 oz. given cold and before meals, while to promote emesis it is given hot and in larger amount.

In the Br. Ph. three preparations are official: *extractum anthemidis* (dose, 2 to 10 grains), *infusum anthemidis*, containing ½ oz to 10 fl. oz. (dose, 1 to 4 fl. oz.), and *oleum anthemidis* (dose 1 to 4 minims).

Chamomile is still considerably used in domestic practice and especially in country districts, but by no means so extensively as formerly, for then indeed it was held almost a panacea, and both the country practitioner and the mother treated with infusion of chamomile colds, coughs, indigestion, and fevers of every type and kind. That such old-fashioned treatment has been improved upon is no doubt true, but the action of chamomile to produce diaphoresis and diuresis, to cause emesis, to relieve flatulence, and to improve digestion is certainly not imaginary, and there can be no doubt that the drug is capable of rendering efficient service in suitable cases.

The main service chamomile performs is as an aromatic bitter in conditions of *digestive atony* and especially in the weakened condition, both digestive and general, occurring in *convalescence* from disease. In such cases the infusion may be given cold in doses of from 1 to 2 oz. before meals. In similar doses and in like conditions, too, it is decidedly carminative, and in the *flatulent colic of children* it is often most effective.

In acute conditions in which sweating is indicated, as in the early days of a "*cold*," in *simple fevers*, in *respiratory catarrhs*, or in *rheumatism*, the administration of infusion of chamomile at bedtime will frequently result in marked relief. It was in such cases that the "old family doctor" so often used the drug, and in spite of therapeutic advances it must be allowed that he might have done much worse.

As emetics, the infusions of anthemis and of matricaria are at times employed, but are scarcely of value sufficient to make them rivals of other drugs employed for this purpose. To matricaria are ascribed virtues as an anthelminthic, and as such it is said to be used extensively in Germany.

The *oleum anthemidis* is thought to have a considerable sedative action on the spinal centres, diminishing their reflex excitability, and its administration for *reflex cough* and for *spasmodic asthma* has therefore been recommended. This action, too, is made use of in the condition of irritability found in *neurasthenic* and *hysterical states*, and, though chamomile alone is seldom employed for such purposes, several preparations are in the market which contain the drug in some form and are of considerable efficiency. Of these the most familiar is named "compound chamomile mixture," and is said to contain cinchona, chamomile, ignatia, phosphorus, nux vomica, and aromatics.

Locally, chamomile is at times employed in a cataplasm which exerts, with heat and moisture, some small amount of sedative effect. The poultice of chamomile may be employed in conditions of *abdominal distress*, and a fomentation in cases of *otalgia*. The oil of anthemis is occasionally added to ointments for use in *skin diseases*, to produce a sedative effect.

Inhalation of the vapour of a hot infusion of anthemis is said to be beneficial in *catarrhs of the upper air-passages*, especially in children and where there exists a tendency to spasmodic complication.

Henry A. Griffin.

CHAMPAGNE.—Used cautiously, sparkling wine of good quality is exceedingly valuable as a stimulant of rapid action, especially in the attacks of mental and bodily depression that often accompany convalescence from *influenza*. Dr. G. E. Buxton (*Jour. of the Am. Med. Assoc.*, July 28, 1894, p. 146) recommends it particularly, in conjunction with strychnine, in the *pulmonary troubles of the aged*, in doses of from 2 to 4 tablespoonfuls, every two hours. For its use as an antemetic, see page 99. Champagne has been thought to be specially conducive to attacks of *gout* in persons of the gouty diathesis, but it is probable that any injurious action of that sort it may have has been greatly overrated. A practical difficulty in the use of champagne in small doses is that of preserving its effervescent property when once the bottle has been opened. Various de-

vices have been resorted to to overcome this difficulty, such as the insertion of a small stop-cock through the cork instead of drawing it, the maturing of the wine in half-pint bottles, etc., but they are all objectionable. A better plan seems to be to open the bottle in the usual way, pour out what is wanted for immediate use, and replace the cork with another, tying the new cork in place and keeping the bottle standing bottom up until it is to be resorted to again.

CHARCOAL.—Freshly burned charcoal consists of almost pure carbon with the addition of the mineral matters of the substances from which it is made. For pharmaceutical purposes it is prepared by the destructive distillation of wood or bones. That from bones (the *carbo animalis* of the U. S. and Br. Ph's; when purified, the *carbo animalis purificatus* of the same Ph's) contains a considerable amount of calcium phosphate, and is used in medicine for little besides the decolourization and filtration of solutions, although it is sometimes substituted for wood charcoal. It may, however, in case of emergency be employed as an antidote in cases of *poisoning by alkaloids*, but not to the exclusion of the proper physiological treatment, etc. Wood charcoal, *carbo ligni* (U. S. Ph., Br. Ph.), *carbo ligni pulveratus* (Ger. Ph.), especially when prepared from soft and spongy wood, absorbs many times its bulk of gases, and when they are of an offensive nature facilitates the action of the oxygen of the air upon them and renders them inodorous. This property is exhibited to the fullest extent when the charcoal is dry, but is in a great measure lost when it is wet or mixed with water. After it has become saturated with a gaseous body it loses its efficiency, but will regain it after having been raised to a dull-red heat. Such great quantities would be necessary to have any appreciable effect in deodorizing large spaces that its use in sick-rooms where there are offensive odours or in privy vaults, etc., is of little value. When, however, the space is limited, as in refrigerators and other places where food is kept, it is of considerable value, but must be renewed every day. In *gangrene* or where there is *foul-smelling suppuration* a poultice containing about 10 per cent. of charcoal will almost completely destroy the fœtor; where poultices are not applicable a sort of quilt or a number of small bags packed with it may be laid over and around the suppurating surface with equally good results. For *offensive leucorrhœal discharges* douches containing the fine powder are often used. In *choleraic diarrhœa* and *epidemic dysentery* charcoal, taken internally, frequently reduces the number of stools and their offensiveness. As a palliative in *pyrosis* and *dyspepsia with acid eructations* it is employed with considerable success. For these latter purposes it is better to add bismuth, and if gas is generated in the stomach during eating the charcoal must be given before meals. It also seems to relieve to some extent the pain of *ulcer* and *cancer of the stomach*. When it is used internally some caution must be observed as to the quantity given and the period during which its use is continued, as it sometimes causes impaction of the fæces. A very fine powder is often used as a dentifrice, but is no better for this purpose than many other substances and is rather objectionable on account of its colour. It is commonly held to render foul water potable, and on this account enters into the construction of nearly all filters. When fresh it undoubtedly improves the odour and appearance of such waters, but whatever virtues it possesses in this direction are soon lost and it becomes of no more value than so much sand. When combined with some adhesive organic body, such as sugar, subjected to great pressure, and recarbonized, it comes out in a dense mass through which water will pass under considerable pressure, and forms a desirable filter, although as soon as it is saturated it becomes impervious and can no longer be used.

Either variety of charcoal may be given in doses of from 20 to 30 grains. The Br. Ph. orders a poultice, *cataplasma carbonis*, made from 1 part of powdered wood charcoal, 3 parts of linseed meal, 4 parts of bread crumbs, and 20 fl. parts of boiling water. The charcoal tablets, *tablettes de charbon*, of the Fr. Cod. each contain about 7 grains of washed wood charcoal. RUSSELL H. NEVINS.

CHARPIE.—See LINT.

CHARTÆ, CHARTULÆ.—See POWDERS.

CHAULMOOGRA OIL (also sometimes written *chaulmogra* or *chaulmugra*), *oleum gynocardiæ*, is obtained from the seeds of a large tree of the Malayan Peninsula and north-eastern part of India, the *Gynocardia odorata*. The oil is obtained from the seeds either by expression or by boiling in water. When sulphuric acid is added to the expressed oil in the proportion of 1 to 20, a green, tenacious, resin-like mass is formed, while the oil obtained by boiling remains clear when treated in the same way. The pure oil has a pale or golden-sherry colour, and, on keeping, deposits granular fat. It remains solid at a temperature of 70° F., but liquefies at about 98·5°. It has an acid reaction due to the presence of palmitic and gynocardic acids, which exist in a free state as well as in combination with glyceryl-forming fats. The active properties of the oil are generally ascribed to the gynocardic acid, which is also sometimes employed instead of the oil and is said to be equally efficacious while less apt to cause gastric disturbance. It may be given in pill, in doses increased from ½ a grain to 3 grains, three times a day, or, as Vidal recommends, in the form of gynocardate of magnesium or sodium, in capsules containing from 3 to 4 grains, of which from ten to twenty are given each day.

When given internally to an adult whose digestive organs are in good condition, 25 drops of the oil produce at first an unpleasant taste in the mouth and some irritation of the fauces. In from fifteen to twenty minutes there succeeds a feeling of nausea, with oppression at the epigastrium and desire to vomit, often accompanied with emesis. Vomiting is more apt

to occur if fluid is taken into the stomach soon after the dose. In an hour or two there is usually slight purging without pain. All these symptoms disappear in two or at the latest three hours. No other symptoms are observed and the urine is not affected. On the other hand, certain individuals show a remarkable tolerance of the drug, and in other cases it may gradually be acquired (Pick, *Viertelj. f. Syph. u. Derm.*, 1880, p. 92). When it is applied externally to the skin but little reaction is produced at first, unless perhaps a slight burning or pricking sensation. If it is frequently applied and well rubbed in an artificial eczema may be produced. If the skin is thin, irritated, or abraded the oil may give rise to suppurative inflammation or even ulceration (Pick). When it is employed as it commonly is, however, once or twice a day, the irritation of the skin is imperceptible and insignificant. The oil is well suited to external applications because of its unctuous smoothness.

In India it has been employed from very remote times, both externally and internally, for a great variety of diseases. It has been highly esteemed in the treatment of *leprosy*, *scrofula*, *phthisis*, *syphilis*, *rheumatism*, and various *skin diseases*, including *scabies*, also as a topical remedy for *neuralgia*, *toothache*, *sciatica*, *stiff joints*, *sprains*, and *bruises*, and both in men and in horses.

As a remedy for *leprosy* it was first introduced to European physicians by Le Page, of Calcutta, and has since been extensively used for this purpose both abroad and in this country with more or less favourable results. Though in India better results seem to have been obtained with the gurjun balsam, elsewhere the testimony has been rather in favour of chaulmoogra oil. While the evidence does not show that the remedy is absolutely curative, many believe that it exerts a favourable effect upon the course of the disease. Under its influence all the symptoms may diminish or even entirely disappear for a time and the patient show marked improvement in weight and general condition; but yet it should be borne in mind that leprosy is a disease in which the progress is often intermittent and subject to prolonged periods of quiescence even when under no treatment. The remedy is administered internally either in capsules containing 4 or 5 drops each or in emulsion in milk, glycerin, or almond oil. The dose at the beginning is usually 4 or 5 drops three times a day, and it may be increased up to 1, 2, or 3 fl. drachms a day. It is said that the best results attend the use of large doses. Externally the oil is applied either by inunction of the pure oil (which melts at the temperature of the body) or of the oil mixed with lard or vaseline, or as an ointment spread on cloths and applied to the diseased surfaces.

In *phthisis* the oil has been employed internally and also externally by inunction to the chest. Though it is said in some cases to moderate the cough, loosen the expectoration, and retard the loss of weight, the testimony in its favour is meagre and not very convincing. The results have been no more favourable in certain diseases of the skin for which it has been recommended. According to Pick, in *lupus*, *eczema*, and *prurigo* they have been wholly negative.—EDWARD B. BRONSON.

CHELIDONIUM (U. S. Ph.), *Chelidonium majus*, *celandine*, a papaveraceous herb formerly official in various European pharmacopœias as *herba chelidonii majoris*, was formerly much used as a purgative, especially in *jaundice*. The dose of the dried plant, powdered, is from 30 to 60 grains. The freshly expressed juice may be given in daily amounts of 10 grains. This juice was formerly applied to *corns* and *warts* to cause their destruction.

CHEMICAL RESTRAINT.—This is a term used in connection with the treatment of the insane. The phrase was introduced about the time that the abolition of mechanical restraint began to be general in asylums. Mechanical restraint, by which is meant personal restraint by means of mechanical devices, such as camisoles, straps, and the like, is now seldom used, if at all, although it is considered by the wisest authorities justifiable in cases of extraordinary suicidal tendencies or proclivities to self-mutilation; in some cases of self-abuse; in certain surgical cases; in extreme violence; and finally in extreme motor excitement tending to rapid exhaustion. As a substitute for mechanical restraint, where abolished altogether, it became necessary at times to have a sufficient number of attendants on hand to hold the patients with their hands. But considerable reliance came to be placed upon the use of drugs of a narcotic order to keep them quiet and prevent exhaustion. The use of drugs for this purpose came to be called, therefore, chemical restraint. This kind of restraint is oftener necessary in conditions of maniacal excitement than in other states, and the drugs chiefly employed for the purpose are hyoscine, hyoscyamine, and duboisine. Chemical restraint was doubtless oftener used than necessary at first, immediately after the abrogation of mechanical restraint. It was soon found, however, that by careful and constant supervision in many acute cases, and by exercise and occupation in chronic cases in the noisy and violent, excited patients became fewer in number in the asylums. The phrase "chemical restraint" is not especially favoured by asylum physicians, because it implies the use of drugs as a mere substitute for mechanical restraint and for the purpose of subduing patients, whereas these agents are employed nowadays solely for the good of the patient, to insure that rest in bed requisite for acute cases in which the patient is in danger of exhaustion, and to induce sleep. There are always certain cases where the employment of hypodermic injections of hyoscine, hyoscyamine, or duboisine is absolutely necessary to the welfare of the patient, though such cases become fewer as the more rational method of attaining the same ends comes more into vogue (hydrotherapy). Chemical restraint is still employed rather too freely in some asylums, with the result undoubtedly of occasionally aggravating the malady from which the patient is suffering.

These particular drugs are powerful and dangerous, affecting as they do both the physical and the mental functions to a very great degree. In healthy subjects their employment induces strange paræsthesias, anæsthesias, muscular paresis, difficulty of speech, delirium, immoderate emotional excitement, often dreadful hallucinations, abnormal dryness of the mouth, and so on. It is not to be wondered at, therefore, that agents of such power for evil in healthy subjects should affect unfavourably, often seriously, the disordered imagination of the insane.—FREDERICK PETERSON.

CHENOPODIUM.—The seeds of *Chenopodium ambrosioides*, var. *anthelminthicum*, popularly known as American wormseed, are official in the U. S. Ph. under this title. At the present time the volatile oil obtained from them, *oleum chenopodii* (U. S. Ph.), is the only form in which chenopodium is used, although the leaves and the freshly expressed juice possess properties similar to those of the seeds, but much less marked. The oil has a very unpleasant odour and taste. In addition to its anthelminthic properties it possesses feeble carminative, diuretic, diaphoretic, and expectorant virtues. It is probably the most efficient remedy we have against *lumbricoid worms*, but its disagreeable features prevent its extended use. It is best administered in doses of from 5 to 10 drops, on lump sugar, every night and morning for three or four days, the last dose being followed by a cathartic. Sometimes it will be found to be advantageous to combine a cathartic, such, for example, as castor oil, with each dose. The powdered seeds may be given in 20- to 30-grain doses. Tablespoonful doses of the freshly expressed juice or a wineglassful of a decoction of 1 oz. of the fresh leaves in a pint of milk are sometimes substituted for the oil, but are by no means so desirable. At times chenopodium seems to have proved effectual in the treatment of *tænia*, but it is so rarely successful that it should hardly be classed as a tæniacide. *Chenopodium botrys* and the ordinary variety of *Chenopodium ambrosioides*, common American plants, possess the same properties as the official variety, but are rarely used except in domestic practice.

RUSSELL H. NEVINS.

CHERRY-LAUREL. — See LAUROCERASUS.

CHERRY, WILD.—See PRUNUS VIRGINIANA.

CHESTNUT LEAVES.—See CASTANEA.

CHIMAPHILA (U. S. Ph.), the leaves of pipsissewa, *Chimaphila umbellata*, an ericaceous plant, is a diuretic that has been much used in the treatment of *dropsy*. The dose of the fluid extract, *extractum chimaphilæ fluidum* (U. S. Ph.), is 2 fl. drachms, three or four times a day.

CHINA.—See CINCHONA.

CHININUM.—See QUININE.

CHINOLINE.—See QUINOLINE.

CHIONANTHUS VIRGINICA. — The root of this shrub, the *Virginia snow-flower* of the Southern United States, has had some repute as a *vulnerary*. The root-bark is thought to be *cholagogue* and *diuretic*, and has been recommended particularly in the treatment of *jaundice* and to relieve *portal congestion*. It contains a glucoside, *chionanthin*, and has been said to contain saponin also. A non-official fluid extract is given in doses of from ½ to 1 fl. drachm, two or three times a day.

CHIRATA, or *chiretta*, is the dried gentianaceous herb *Swertia* (or *Ophelia*) *Chirata*, found in the mountains of northern India.

It is a *bitter tonic*, diminishing *acidity* and *flatulence*, and it is believed to exercise a distinct effect upon the liver. H. Hoehn isolated from the plant a bitter, amorphous, viscid substance, *ophelic acid*, $C_{13}H_{20}O_{10}$, and a bitter crystalline substance, *chiratin*, $C_{26}H_{48}O_{15}$, both of which are soluble. It contains no tannic acid, and is therefore an excellent bitter to combine with iron. The dose of the powder is from 20 to 40 grains.

The fluid extract, *extractum chiratæ fluidum* (U. S. Ph.), is given in doses of from 10 to 20 minims. The dose of the tincture, *tinctura chiratæ* (U. S. Ph., Br. Ph.), is from ½ to 2 fl. drachms. The dose of the infusion, *infusum chiratæ* (Br. Ph.), is from 1 to 2 fl. oz. An unofficial solid extract is made that may be given in pills or capsules in doses of from 2 to 4 grains.

In India chirata is considered to be a very valuable tonic and a restorative for all forms of *exhaustion*. It is used in *dyspepsia*, in *dysentery*, and in *malarial fever* and especially the chronic forms of paludal poisoning, for which it has been held to be superior to quinine. It should be given some time before eating when it is used to promote the appetite. It may be used in all conditions in which gentian and cinchona are employed.

SAMUEL T. ARMSTRONG.

CHLORACETIC ACID, formed from acetic acid by the substitution of chlorine for hydrogen, is found in three forms, the *monochloracetic*, *dichloracetic*, and *trichloracetic acids*, all of which are caustic. The last mentioned is the one commonly employed and comes in the shape of crystals which are used to destroy *papillomata*, *warts*, *nævi*, and similar growths. They are very effectual and cause little pain. A 20-per-cent. solution can be substituted for silver nitrate in the treatment of gleet; it is just as effectual and gives rise to little pain. A solution of the strength of from ½ to 1 per cent. has been highly recommended in the treatment of *ozæna*.

RUSSELL H. NEVINS.

CHLORAL is a clear, colourless liquid of limpid and oily consistence. It is possessed of a pungent and disagreeable odour, but of little taste. It is freely miscible with water, alcohol, ether, or chloroform, the two former producing in it changes presently to be described, the two latter producing none. It is made by the action of dry chlorine gas upon anhydrous alco-

hol, and is purified first by treatment with sulphuric acid and afterward with lime. Its formula is C_2HCl_3O. On account of the wide-spread misapplication of the name chloral to *chloral hydrate*, chloral is often referred to as anhydrous chloral by those who are careful to distinguish it from hydrous chloral, or chloral hydrate, the crystalline drug used in medicine. Chloral itself is not so employed.

Chloral ammonium, *trichloramido ethyl alcohol*, CCl_3,CH,OOH,NH_2, is a white crystalline powder, soluble in alcohol and less soluble in water. It is used in *nervous insomnia*. The dose is from 15 to 30 grains.

Chloral alcoholate is a white crystalline substance resembling chloral hydrate and resulting from the action of absolute alcohol on anhydrous chloral. Its formula is C_2HCl_3O, C_2H_6O. It is not employed in medicine.

Chloral caffeine occurs in white scales. It is soluble in water, and decomposed by alkalies. It is formed by the union of chloral and caffeine, and its formula is $C_8H_{10}N_4O_2.CCl_3CH:O$. It has been used for *neuralgias* and *asthmatic attacks*, and particularly by hypodermic injection. The hypodermic dose is from 3 to 4½ grains, and its administration is said to be painless.

Camphorated chloral, *chloral camphoratum* (Nat. Form.) is a clear liquid resulting from the trituration together of equal parts of camphor and chloral hydrate. Its main employment is as a local application for the relief of *neuralgias*, for which it is excellent, but it has occasionlly been given internally in doses of from 10 to 20 drops, and is a powerful sedative narcotic.

Chloral formamide, *chloralum formamidatum* (Ger. Ph.).—See Chloralamide.

Chloral hydrate, *chloral* (U. S. Ph.), *chloral hydras* (Br. Ph.), *chloralum hydratum* (Ger. Ph.), is often called *hydrous chloral* for the sake of avoiding the confusion already referred to. It results from the union of anhydrous chloral and water, and is described by the U.S. Ph. as "a crystalline solid, composed of trichloraldehyde or chloral with one molecule of water." Its formula is $C_2HCl_3O.H_2O$. It occurs as "separate, rhomboidal, colourless, and transparent crystals, having an aromatic, penetrating, and slightly acrid odour and a bitterish, caustic taste; slowly volatilized when exposed to the air" (U.S. Ph.). It is soluble in water, in alcohol, in ether, in chloroform, and in the fixed and volatile oils. It is liquefied by trituration with an equal quantity of camphor, menthol, thymol, or carbolic acid. Besides the official, crystalline form of chloral hydrate we find in commerce another variety forming thin crystalline plates or cakes broken into irregular pieces. This form, though cheaper than the official, is to be avoided for medicinal use, on account of the presence of impurities in it. Chloral hydrate must be kept in glass-stoppered bottles, and in a cool, dark place.

Chloral hydrate was discovered by Liebig in 1832, but it was not until 1869 that it was employed in medicine. It was in that year that Liebreich, of Berlin, introduced it, and the use of the drug soon became enormous and has continued so. Liebreich's idea was founded upon the knowledge that chloral hydrate in contact with alkaline solutions was converted into chloroform and formic acid, and he was under the impression that this decomposition would occur after the absorption of chloral by the blood, on account of the alkalinity of that fluid. The effect of the chloral was therefore believed to be due to the action of chloroform thus generated. As a matter of fact, there are many reasons which contradict this belief, but it will suffice to say here that there is no chemical evidence of the presence of chloroform in the blood of one to whom chloral has been given, though it is readily detected in the blood after it has been administered as chloroform. Liebreich's theory is therefore not entertained at the present time.

The local action of chloral hydrate is highly irritating as well as anæsthetic, and its application in crystals, or in concentrated solution, to mucous membranes, or even to the skin, will result in blistering. Its use as a vesicant, however, is objectionable, for, though it causes less pain than cantharis does, it is apt to cause sloughing, an accident all the more likely to occur by reason of the anæsthesia it produces. Irritating effects, too, may follow its internal administration in large though not concentrated doses, and occasionally it produces nausea, vomiting, and diarrhœa. Chloral hydrate is also an *antiseptic* of considerable power.

The physiological effects of chloral hydrate which follow its internal administration are most important. Upon the brain it acts to diminish its activity, and is a hypnotic of great power. Large doses depress the centres at the base of the brain and those of the spinal cord, and circulatory and respiratory disturbances follow, together with muscular weakness, diminished reflex irritability, and some degree of anæsthesia. These muscular phenomena must, however, be attributed to the central action of the drug, for upon the muscles it has practically no effect. Upon the heart small doses produce little or no effect, though the condition of that organ, as well as idiosyncrasy, has much to do with the circulatory phenomena caused by chloral. Large doses, on the other hand, slow and weaken the heart's action, while the effect of poisonous doses is to make it rapid, feeble, and irregular, and finally to cause cardiac arrest in diastole. The cause of these symptoms is probably nervous, though some ascribe to the drug a paralyzing action upon the cardiac muscle. Upon the blood pressure the effect of chloral hydrate is, first and temporarily, to cause its increase, but this is soon followed by a fall due both to a depression of the vaso-motor centre and to a weakening of cardiac force. The action of full doses of chloral hydrate upon the respiratory centre results in a slowing of breathing, and poisonous doses may kill by respiratory paralysis. Large doses cause a fall of temperature which may be considerable, but the antipyretic effect of chloral hydrate is purchased only by the administration of doses so large as to be dangerous. Upon the secretions the drug has little effect, though glycosuria has been thought to follow its use in some cases. Its excretion

takes place principally from the kidneys, and mainly in the form of urochloralic acid. An effect upon the kidneys which, it is said, is occasionally observed is the production of renal irritation and even of hæmorrhage.

The action of chloral hydrate which makes it a drug of such value is that of cerebral and spinal sedation, and its therapeutic applications are therefore mainly to produce sleep and to oppose spasm. The administration of a therapeutic dose is usually followed in from a quarter to half an hour by a quiet and natural sleep which lasts from three to six or even eight hours. This sleep as a rule is refreshing and dreamless, and, though it is light and the patient may easily be aroused to complete consciousness, he soon passes again into his natural sleep. The production of sleep by chloral hydrate is not invariable and is affected by many things, especially the size of the dose, the nature of the disease, and the idiosyncrasy of the patient, but it is sufficiently constant, and the sleep is so natural that chloral hydrate is to be considered the most valuable pure hypnotic we possess. Small doses are not seldom unreliable in action, and even large doses are at times unproductive of sleep and occasionally, too, apparently the cause of the greatest excitement. Exceptionally also the sleep caused by chloral hydrate is not quiet and refreshing, but restless and disturbed by disagreeable dreams. Though anorexia, nausea, headache, and nervous depression are unusual sequels of its administration, they are observed at times, but certainly less often than from the use of the hypnotic drugs in general, and when they do occur they sometimes appear to be the result of the impurities the drug contains. The therapeutic use of chloral is usually unaccompanied by circulatory and respiratory disturbance, but large doses produce a deeper and more stuporous sleep, with slowed pulse and respiration, somewhat lowered temperature, and muscular relaxation. Chloral hydrate, however, is at times erratic, and small doses may produce most pronounced symptoms; poisoning even has resulted from doses not unusually large.

Poisoning by chloral hydrate.—Two forms of poisoning are recognised, the acute and the chronic. The latter is generally described as "the chloral habit" and sometimes as chloralism.

The amount of chloral hydrate necessary to produce acute and fatal poisoning can not be stated definitely, for, though 10 grains are said to have caused death in one case and 30 grains have certainly done so in several cases, yet the effects of a dose so large as 480 grains have been recovered from. Habit, too, would seem in some degree to afford tolerance.

The symptoms in persons acutely poisoned are stupor, deepening into coma; pallor, with a moist and clammy skin; a rapid, feeble, and irregular pulse, which may become imperceptible; slow and shallow respiration; lowered temperature; great muscular relaxation, with loss of reflex irritability; the pupils at first contracted but afterward dilated; and, finally, paralysis and anæsthesia. Death results from paralysis of the respiration or of the circulation. In treating such cases, if they are seen sufficiently early, the stomach should be emptied, preferably by the stomach-tube, and stimulants, both circulatory and respiratory, should be administered freely. At first the diffusible stimulants, alcohol, ether, and ammonia, are to be given hypodermically, and soon followed by digitalis, the effect of the former serving to support the patient until the digitalis has time to act. Atropine and strychnine are especially valuable because of their power to stimulate the respiratory centre, and should be given freely by hypodermic injections. Heat should be applied to the surface, and, as in opium poisoning, the patient should be aroused from his stupor as much as possible, though, owing to the embarrassment of the circulation, the greatest care must be observed to prevent exhaustion. For this reason walking the patient about is seldom applicable in poisoning by chloral hydrate. Careful watch must be kept of the breathing, and if it shows signs of failing, artificial respiration must be practised before it ceases.

The chronic form of poisoning results from the habitual use of the drug. The symptoms are not the same in all cases, but the victim will present various combinations of the following: Intellectual weakness and sluggishness, which are usually present and may amount to dementia; disturbances of motion and sensation, especially of the lower extremities, which are common; dizziness and tinnitus. The digestion is generally impaired and dyspeptic symptoms are present, while the stools are often clay-coloured and pasty. Jaundice occurs at times and even more commonly bile pigment is present in the urine. Sleep without the customary dose of the drug is practically impossible, and nervousness and excited restlessness take its place. There is severe dyspnœa present in many cases and disturbances of the circulation are very common, especially cardiac irritability, palpitation, and syncope. Many of these patients present cutaneous eruptions, particularly erythemata. This flushing is especially likely to occur on the face and is more pronounced when alcohol is taken. Besides erythema there often occur dilatation of the cutaneous vessels and very often those of the conjunctivæ, urticaria, purpura, and spongy and bleeding gums, while ulcerations about the nails even have been attributed to the prolonged use of chloral hydrate. The treatment of chloralism requires the gradual diminution and final relinquishment of the drug and the temporary substitution for it, if necessary, of mild soporifics, such as lupulin and hyoscyamus. Hygienic, tonic, and moral remedies also are almost invariably required.

The condition most appropriately treated by chloral hydrate is pure *nervous insomnia*, if not habitual or requiring the continued use of a drug. The administration of the drug is our surest means for the relief of this condition. In the *restlessness* and *delirium of fever*, too, it will be beneficial, but should never be employed if the fever is asthenic, on account

of its depressing action upon the circulation. Some slight benefit, too, may occur in the febrile state from its power to reduce temperature, but as an antipyretic it requires to be given in large doses, and such employment of it is therefore dangerous and not to be allowed. In the *excitement of insanity* it often works well, and in *delirium tremens* it is our greatest reliance, especially if given together with a bromide. The doses required for this condition are rather larger than usual, and the best way to give it is in doses of from 15 to 20 grains, which may be repeated once or even twice at intervals of an hour. A special caution, however, must be observed in giving it to old alcoholics, on account of the almost invariable presence of circulatory disease in them. The relief of alcoholic delirium by chloral hydrate is certainly not invariable, but it is more certain than from any other drug. Occasionally, however, chloral not only fails to quiet the patient, but even seems to be the cause of an increased excitement. The use of chloral hydrate for the relief of insomnia due to pain is irrational and dangerous, for the drug produces anæsthesia only when given in toxic doses. For such cases opium is invariably to be preferred.

The relief of *convulsions* is an application of chloral hydrate second only in value to its action as a hypnotic. In the convulsions of *tetanus* and *strychnine poisoning* it is our most valuable agent and must be given freely. In *puerperal convulsions* it is serviceable, and for the *convulsions of childhood*, which are so often reflex, it is of the greatest value, especially if given together with a bromide. The dose of chloral hydrate for children is 1 grain for each year of age. It may be used for the convulsions of *epilepsy*, but is less valuable than the bromides. Other spasmodic conditions are often much benefited by the administration of chloral hydrate, especially *laryngismus stridulus*, *asthma*, *whooping-cough*, and *hiccough*. Its occasional administration is thought to be of benefit in *paralysis agitans* and *chorea*. Akin to this employment of the drug is its action in promoting the relaxation of the *rigid os uteri* in the first stage of labour, an action of which the value is not to be overestimated. It is occasionally used also to diminish the *violence of the uterine contractions* in the first stage of labour and for the relief of *after-pains*.

Other ailments are often benefited by the use of chloral hydrate, and among them *sea-sickness*. In this condition the administration of from 15 to 30 grains at intervals of four hours, together with a suitable diet and the maintenance of the recumbent posture for a time, is held by Bartholow to be of great service. Other forms of *reflex vomiting* are also occasionally treated by the use of chloral hydrate. The hypodermic administration of chloral hydrate was recommended by Hall in the algid stage of *cholera*, but, apart from the objections to its subcutaneous administration, there is the more valid objection that it does little or no good. Chloral hydrate has recently been advanced as a specific in *scarlet fever*, but its value in this disease remains to be proved.

The use of chloral hydrate as a *vaso-dilator* is one seldom referred to in text-books, but is none the less one of the utmost value. For this purpose the usual dose is 5 grains, given as often as every three hours, though not seldom a lesser frequency will suffice. Its power to cause arterial relaxation is a pronounced one and far greater and more reliable than that of nitroglycerin, and, though the potency of the drug and its treachery are not to be lost sight of, it is indicated in all cases in which arterial tension is greatly increased and cardiac action is thereby obstructed, especially if the milder vaso-dilators, such as nitroglycerin have failed. For this purpose the drug is highly recommended by Delafield. Though organic circulatory disease is generally held a contra-indication to the use of chloral hydrate, the arterial contraction is often a more imminent danger in such cases than the disease which it accompanies, and therefore is a direct indication for vaso-dilatation, and, if necessary, by chloral.

Besides its internal use, chloral hydrate is occasionally used locally. Thus, a solution of from 5 to 30 grains to 1 oz. may be applied as a stimulant to *foul ulcerations*, and acts also to some degree as an antiseptic. Its antiseptic and sedative properties make the application of similar solutions to *wounds* and *burns* at times desirable, and in skin diseases attended with *itching* the use of solutions varying in strength from 1 to 4 per cent. is exceedingly sedative. The anæsthetic action of chloral hydrate is made use of in the treatment of *toothache*, from which great relief will often follow the packing of a cavity in a carious tooth with cotton soaked in a concentrated solution of the drug. A solution of from 1 to 4 grains to 1 oz. may be employed as an injection in *gonorrhœa*. The antiseptic action of the drug is also made use of in the preservation of anatomical specimens (a solution of 30 grains to 1 oz. will do this) and urine, and the prevention of fermentation and a foul odour in urinals is accomplished by placing the undiluted drug in them.

The *contra-indications* to the use of chloral hydrate are asthenia, nervous instability, circulatory weakness, cardiac degeneration, and arterial disease, unless, as has already been shown, arterial contraction is present and sufficient to be in itself a danger. Its administration is also inadvisable in pulmonary disease, especially if extensive or advanced, on account of the effect of the drug in favouring pulmonary congestion.

The dose of chloral hydrate will vary with the circumstances. Wood puts the highest safe dose at 20 grains, but allows its hourly repetition until 60 grains have been given. Its administration is then to be suspended for several hours unless the necessity is great. The first dose for an adult should not exceed 15 grains, and if there is the slightest question of circulatory impairment 10 grains must be the limit. The administration should at first be infrequent also, though a single repetition after an hour or two is allowable if necessary. As has been said, the dose for children is 1 grain for each year of age. The drug

should be given largely diluted to avoid its irritating effects, and water or sweetened or orange-flavoured water or milk is the usual vehicle. It is active also if given by enema, but its employment thus should be in large dilution. The hypodermic administration of chloral hydrate has been practised, but is painful in the extreme and is likely to be followed by phlegmonous inflammation. It is, therefore, not to be recommended. Intravenous injections were at one time done, especially by the French, but the dangers of this practice are so great, both from thrombosis and from the sudden precipitation of the entire dose upon the nerve centres, that it is inadmissible.

There exists but one official preparation of chloral hydrate, the syrup, *syrupus chloral* (Br. Ph.), which contains 10 grains of the drug in each fl. drachm. The dose is from ½ to 2 fl. drachms. There are several unofficial preparations, however, and one especially popular in France is "*chloral cream.*" This is composed of 5 parts of chloral hydrate, 15 of water, and 100 of powdered white sugar, and flavoured with mint or vanilla. One grain of chloral hydrate is contained in 24 grains of the cream. It is given in water. *Chloral liniment* contains 6 parts of chloral hydrate dissolved in 30 parts of oil of sweet almonds. *Chloral ointment* contains 6 parts of chloral hydrate, 3 of white wax, and 27 of lard. *Chloral plaster*, a counter-irritant and vesicant, is made by spreading powdered chloral hydrate upon Burgundy-pitch plaster. [Cf. HYPNOTICS.]

HENRY A. GRIFFIN.

CHLORALAMIDE, *chloral formamide, chloralum formamidatum* (Ger. Ph.), $CCl_3-CH\begin{cases}OH\\CONH_2\end{cases}$, is formed by the action of formamide upon chloral. It occurs in lustrous, colourless crystals, somewhat bitter, soluble in about 20 parts of cold water or in 1½ part of 96-per-cent. alcohol. It is decomposed by water at 140° F. and by alkalies, but not by dilute acids.

From experiments upon animals it appears that the physiological action of chloralamide is similar to that of chloral upon the cerebrum, producing drowsiness and sleep, but its action upon the circulation is ordinarily so slight as to offer a marked contrast to the depression produced by chloral. In very large, poisonous doses only does chloralamide depress the heart and produce a fall in the blood-pressure. A moderate degree of respiratory depression may follow the administration of large amounts, and death in animals results from paralysis of respiration. It has been thought to have a soothing effect upon the spinal centres and thus to diminish reflex excitability, but its action upon the nervous system other than the cerebrum is hardly appreciable. It is excreted as urochloralic acid.

Poisoning by chloralamide is occasionally seen but hardly ever reaches a severe grade. The symptoms noted in such cases as have been described are usually chilly and febrile sensations, sweating, disturbances of cardiac rhythm and force, nausea, vomiting, and respiratory depression; but such ill effects have never occurred save after doses unusually large.

Though some have thought chloralamide useful in spasmodic and painful affections, it must be confessed that the use of this drug is practically limited to the production of sleep. As a hypnotic it is fairly efficient, acting well in the slighter grades of *insomnia*, especially if purely nervous in origin, generally failing in sleeplessness of greater severity, and ranking in value and reliability rather below sulphonal. It certainly can not be compared with chloral in effectiveness, though it has the appreciable advantage over that drug of causing little or no circulatory depression when given in ordinary doses. For this reason it is safer than chloral for persons with embarrassed circulation. It not only oftener fails entirely to produce sleep, but is of far slower action than chloral. If sleep is produced it is usually quiet and natural, and its duration is from four to eight hours.

It has too often been said that chloralamide has no disagreeable or objectionable after-effects, but, while they are not so common as to militate strongly against the use of the drug in suitable cases, headache, confusion, dizziness, anorexia, and nausea are sequels of more than occasional occurrence. Eruptions, too, have been reported as following the administration of chloralamide, but they are not common. Their character is usually erythematous or macular.

In administering chloralamide for its hypnotic effect the usual dose is from 30 to 45 grains, given in water, wafer, or capsule about an hour before the time when sleep is desired. Exceptionally a more rapid effect will be perceived, but not uncommonly the action is considerably slower. The drug is also efficient when given by the rectum.

The *insomnia* in which chloralamide acts best (and here it is often of considerable value) is that of moderate grade and due to pure nervous influences, for here it seems just sufficient to quiet the cerebrum, the over-activity of which is functional and not organic or symptomatic of grave disease. In the insomnia of acute febrile disease it is not infrequently effective, but less so than in nervous insomnia and generally only in mild or moderately severe cases. In insomnia due to pain it generally fails. Chloralamide is utterly powerless against the severer grades of insomnia, whatever their cause, and in delirium tremens and the insomnia occurring in the various forms of insanity it is practically worthless.

The usefulness of chloralamide in painful diseases is generally denied, and yet there are those who think highly of it even in such painful conditions as the severer forms of *neuralgia*. There seems no reason to accord to chloralamide any other than a most unreliable and occasional action as an analgetic. Chloralamide has been thought to be of benefit in certain spasmodic diseases, notably *chorea, epilepsy*, and *spasmodic asthma*, but it is not to be relied on. Like many another drug, chloralamide has been tried and thought effective in the

treatment of *seasickness*. The use of it for this purpose is so new, however, that as yet definite conclusions as to its merit are not warranted, but, as it is given in such cases in combination with potassium or sodium bromide (30 grains of each), either of which rather more than any other drug has seemed to affect this obstinate condition, and, moreover, is administered on an empty stomach at the time of sailing, subsequent rest and sleep being insisted on, success may be due to something else than the chloralamide.—Henry A. Griffin.

CHLORALOSE, $C_8H_{11}ClO_6$, is formed by heating a mixture of glucose and anhydrous chloral. It occurs in fine white crystals, slightly bitter, soluble with difficulty in cold water, but readily soluble in hot water. It has recently been introduced as a hypnotic and analgetic. Mr. Charles Flemming (*Practitioner*, July, 1894) has used it successfully in *uterine pains*, *hysterical headache*, *sleeplessness*, *hysterical chorea*, and *neurasthenia*. It has one very important defect, and that is that it occasionally provokes toxic symptoms which manifest themselves by an exaggeration of the reflex excitability of the medulla oblongata amounting almost to convulsions; in addition to this it is very difficult to decide upon the proper dose, as its action varies not only in different persons, but even in the same person. It seems, however, from observations made by M. Khmelewsky in cases of different forms of *lunacy* and in others of *psychical troubles*, that frequently the dose of 8 grains is sufficient to produce quiet sleep. In cases of secondary psychosis without much agitation the hypnotic effect may be obtained with 6 grains. If the dose of 10 grains is exceeded, toxic symptoms are observed in the majority of cases, and in subjects, too, whose nervous system is normal. These symptoms may appear also after the use of smaller doses in weak or hysterical persons or in the subjects of alcoholic poisoning. In other forms of psychical or nervous disorders doses of from 4 to 8 grains of chloralose rarely give rise to accidents. These toxic symptoms are convulsions more or less generalized, and they are accompanied by involuntary emission of urine; but, notwithstanding their apparently alarming character, they disappear rapidly and do not give place to any serious or lasting nervous troubles or to any painful sensations. It is best to administer chloralose in very moderate doses, beginning with 2 grains and increasing the dose to 3 and then to 4 grains.

CHLORALUM.—See Chloral, also under Aluminum and its salts.

CHLORANODYNE.—An American proprietary compound resembling chlorodyne, said to consist of 1 part each of morphine hydrochloride and oil of peppermint, 5 parts of tincture of cannabis indica, 30 parts of chloroform, 4 parts of hydrocyanic acid, 60 parts of alcohol, and 120 parts of glycerin.

CHLORIC ETHER.—The *spiritus chloroformi* of the U. S. and Br. Ph's. See under Chloroform.

CHLORINE is a greenish-yellow gas with a suffocating, insupportable odour, about two and a half times as heavy as air, with a strong affinity, at ordinary temperatures, for nearly all the metals and a powerful decomposing action upon all organic matter, which action is, however, not well marked except in the presence of moisture. If present in the air in the proportion of one part in a hundred, it is a most active germicide and disinfectant, provided the objects subjected to its influence are damp as well as the chamber, etc., in which they are contained, and provided that it is allowed to exert its influence for at least an hour. All phosphoretted, sulphuretted, ammoniacal, and offensive hydrogen compounds are rapidly decomposed into inoffensive bodies when exposed to it, and hence it is of great value as a deodorizer. In its pure state it is rarely, if ever, used save when set free by the action of an acid upon a chloride, the most usual method being to add a small amount of dilute sulphuric acid to chlorinated lime or to mix alum with it, which latter plan is rather more desirable, as the gas is evolved more slowly than when the acid is used. The chlorinated lime must not be confounded with calcium chloride, for in reality it is a mixture of calcium chloride and calcium hypochlorite. Being more or less destructive of fabrics, those of silk or wool resisting its action the least, and rapidly affecting all metals, chlorine is not generally applicable for disinfecting, and for ordinary purposes is not so desirable as the fumes given off by burning sulphur. Where, however, as in stables, outbuildings, etc., from which all bodies liable to be injured by it can easily be removed, it is an extremely valuable agent on account of its effectiveness and the facility with which the chlorinated lime, or bleaching powder, can be obtained and its relatively low cost. In many cases the addition of sulphuric acid or of alum will not be necessary, as there is sufficient carbonic acid in the air to decompose it. Of course it is always essential to close all openings, and it is a very good plan when practicable to introduce a small amount of steam, so as to saturate the air with moisture as nearly as possible. Also, being destructive of life, chlorine may be used to kill rats, mice, and other vermin, and this use of it is much better than the ordinary method of exposing poisoned food, as it corrects the bad odours arising from the decomposing animals. Being heavier than air, it will penetrate all the nooks and crannies, if the lime is placed in the highest portion of the building, ship, or the like, submitted to its action. A solution of 1 part of chlorinated lime in 100 parts of water forms a very desirable sprinkling mixture for use in all places, such as privy vaults, stables, etc., where there are unpleasant odours, and it may be employed to prevent the effluvia from dead bodies, which should be wrapped in a sheet soaked in the solution. It is said that a solution of this strength is suitable for soaking the bedding, etc., of those affected with contagious diseases, but it is more than probable that it would injure the fabrics, hence one containing zinc chloride or corrosive sub-

limate is much to be preferred. For the reception of the fæces, sputa, urine, etc., of persons having contagious diseases there is nothing better than chlorinated lime, which should be placed in the vessels prior to their receiving the discharges mentioned. It has sometimes been employed to correct the offensive odour acquired by drinking water during long sea voyages, 1 oz. to each barrel being the amount generally used.

Chlorine, when inhaled in sufficient quantities, is very poisonous, causing marked spasm of the glottis and speedy asphyxia, so that little probably enters the lungs. If any opportunity is afforded, ammonia is the chemical antidote to be used, as its vapour combines with the chlorine, forming the relatively harmless ammonium chloride. In smaller amounts chlorine acts as a stimulant of the mucous membrane of the respiratory tract and excites severe coughing, increases the secretions, and may give rise to hæmorrhages. Combined in minute quantities with air and inhaled, it has been employed in the treatment of *phthisis* and chronic pulmonary affections with some reported good results.

Chlorine water, *aqua chlori* (U. S. Ph.), *liquor chlori* (Br. Ph.), *aqua chlorata* (Ger. Ph.), is intended to be a saturated solution of chlorine in water, each volume of which should contain about 2½ volumes of chlorine. It is an easily decomposed solution, and must not be mixed with other substances; moreover, it must be preserved in coloured bottles in a dark place. It has the same antiseptic properties as chlorinated lime, but its cost and instability render it less available, and it is chiefly employed as a stimulant and antiseptic application to *ill-conditioned* and *foul-smelling ulcerations* and *gangrenous tissues* or to wash out *abscesses* and as a gargle in *diphtheria*, *scarlet fever*, and *aphthous throat affections*. Formerly it was employed internally in the treatment of the various zymotic diseases, but is of little or no value in those conditions. It may be given in doses of from 1 to 4 fl. drachms, well diluted. To wash out the pleural cavity after operations for *empyema* it is entirely safe, and it may be employed as a vaginal douche in *septic conditions after childbirth*. The solution of chlorinated soda, *liquor sodæ chloratæ* (U. S. Ph.), *liquor sodæ chlorinatæ* (Br. Ph.), or Labarraque's solution, owes its properties to the chlorine compounds it contains. It may be used externally for the same purposes as chlorine water, and, being cheaper, is a convenient household disinfectant.

[The chlorine poultice, *cataplasma sodæ chlorinatæ*, of the Br. Ph. is made with 2 fl. oz. of this solution, 4 oz. of linseed meal, and 8 fl. oz. of boiling water. The meal is gradually mixed with the water, and the solution of chlorinated soda is added, with constant stirring.]

The solution of chlorinated potash, *liquor potassæ chloratæ*, or Javelle water, although possessing the same properties as the last-named preparation, is rarely used except for the purpose of removing stains from fabrics. On account of its astringent properties, a solution of zinc hypochlorite has been used where such astringent effect as well as an antiseptic one is desirable in affections of the mucous membranes, etc.

Chlorinated cotton is prepared by subjecting absorbent cotton impregnated with glycerin to the fumes of chlorine. It may be applied over gangrenous parts, etc., to correct the fœtor arising from them.

The chlorides of the different bases have no general properties in common save those, as a rule, of being soluble, more or less hygroscopic, and irritating to mucous membranes or raw surfaces. Those of the alkaline bases, taken in considerable quantities, are emetic and cathartic and those of zinc and copper caustic. Poisoning may sometimes result from them, especially from those of zinc and copper, and should be treated by the administration of demulcents, albumen, opium, etc.

RUSSELL H. NEVINS.

CHLOROBROM.—This fanciful name has been given to a solution of 30 grains each of chloralamide and potassium bromide in 1 oz. of water, flavoured with extract of licorice, first used by Charteris as a remedy for *seasickness* (see the article on ANTEMETICS, p. 100). It has been used also with some success in cases of *persistent vomiting* not due to seasickness. Dr. John Keay, of Edinburgh (*Lancet*, March 18, 1893, p. 587), has found it an excellent remedy for *insomnia* in melancholiacs and in persons who are exhausted by excessive brain-work or by worry over business matters. He thinks it particularly valuable in *active melancholia*, but of little use in the excitement of mania, general paresis, epilepsy, etc. On the other hand, Dr. J. Percy Wade, of the Maryland Hospital for the Insane (*Am. Jour. of Insanity*, Apr., 1895, p. 492), has found it valuable in *simple melancholia*, but not in active melancholia. In general terms, he agrees with Dr. Keay that it is a safe and reliable hypnotic. The dose generally employed by him was 1 oz.

CHLORODYNE.—This is a very popular British proprietary anodyne preparation the formula of which is credited to Dr. J. Collis Browne. It is said to consist of 4 fl. drachms of chloroform, 20 grains of morphine hydrochloride, 2 fl. drachms of rectified ether, 8 minims of oil of peppermint, 4 fl. drachms of dilute hydrocyanic acid, 6 fl. drachms of tincture of capsicum, 1 fl. oz. of mucilage of gum arabic, and enough treacle to make 4 fl. oz. (For the formula of a similar preparation, see the article on CHLOROFORM.) If this formula is correct, 12 minims (not drops) of chlorodyne contain ⅙ of a grain of morphine. The dose is from 10 to 15 minims, well diluted with water. It is used as an anodyne and carminative in acute attacks of *diarrhœa* and *colic*.

CHLOROFORM, *chloroformum* (U. S. Ph., Br. Ph.), *chloroformium* (Ger. Ph.), was discovered independently by Guthrie in America and Soubeiran in France in 1831. Neither had any suspicion, however, of its wonderful therapeutic properties, and it was not until

1847 that it was first used in medicine. In the summer of that year chloric ether, of which chloroform was the principal ingredient, was used in St. Bartholomew's Hospital, London, to produce insensibility to pain; and in November Sir James Y. Simpson, of Edinburgh, administered its vapour to produce anæsthesia during surgical operations.

Chloroform, $CHCl_3$, is a limpid, colourless liquid of ethereal odour and slightly acrid, intensely sweet taste. Its density is 1·499 at 60° F., and it burns with a greenish flame when thrown upon red-hot coals, breaking up into free chlorine, hydrochloric acid, and other irritating compounds of chlorine. This action also goes on where the vapour has access to a naked light, especially if the atmosphere is moist, and several cases have been reported of bronchitis, and even pneumonia, following its administration in a small closed room with a gas jet burning. In these cases both operators and patient were affected. Chloroform is readily soluble in spirit, 10 to 7; freely also in oils and turpentine; and but slightly in water, 1 to 200.

When *applied locally*, chloroform acts as an irritant with mild anæsthetic properties. Where the vapour is confined, as by applying it under a cupping glass or covering the part with a rubber sheet, the irritant action is sufficiently intense to cause vesication. Combined with the anodynes in the form of a liniment, it allays the pain of *chronic rheumatism*, *lumbago*, and *neuralgia*. Here, besides adding the anæsthetic effect of the chloroform to the anodyne with which it is combined, it aids in the absorption of the latter; and to obtain the full effect, too rapid evaporation of the chloroform should be prevented by a covering of oiled paper. Equal parts of the liniments of chloroform and of belladonna are very useful in this class of cases. Two parts of camphor rubbed up with 1 part of chloroform and applied on cotton wool answers well in *toothache*.

[The *linimentum chloroformi* of the U. S. Ph. consists of 3 volumes of chloroform and 7 of *linimentum saponis;* that of the Br. Ph., of equal volumes of chloroform and *linimentum camphoræ*. The British preparation, therefore, is somewhat stronger than the American.]

As a lotion, in the proportion of 1 fl. drachm to 1 fl. oz. of olive oil, it allays for a time the intense itching of *urticaria* and *pruritus* generally; the same strength, with the addition of ½ a fl. drachm of ether, has been highly recommended for application to a *rigid perinæum* in labour.

By the mouth chloroform is given in doses of from 3 to 10 minims, freely diluted. Considerable doses of pure chloroform, however, may be taken into the stomach without causing death by poisoning: recoveries following 1 fl. oz. and 1½ fl. oz. have been recently reported. Taken in the official dose, it acts as an antispasmodic and sedative, relieving *pain*, *flatulency*, and *vomiting;* the larger dose exerts its narcotic effect, and after using the stomach-tube the same measures for relief should be used as after an overdose by inhalation.

Added to mixtures in the form of *aqua* or *spiritus chloroformi* (U. S. Ph., Br. Ph.), it forms one of the best means of disguising nauseous or bitter drugs, and its own action is never contra-indicated. The spirit is a valuable remedy in persistent *hiccough*, and it has been found, when taken in drachm doses, sometimes to avert the chill of *intermittent fever*. Chloroform forms one of the active components of a popular secret remedy sold under the name of chlorodyne, to which the following (Martindale) bears a close resemblance:

Chloroform,	
Rectified spirits, each	2 fl. oz.;
Treacle	4 fl. oz.;
Liquid extract of licorice. .	1½ fl. oz.;
Hydrochloride of morphine	40 grains;
Sulphate of atropine	1 grain;
Oil of peppermint.........	8 minims;
Dilute hydrocyanic acid. . .	160 minims;
Tragacanth in powder	20 grains;
Distilled water, enough to make..................	10 ounces.

Dose, 5 to 20 minims. It forms a useful sedative in *diarrhœa*. The *mistura chloroformi et opii* (N. F.) and the *tinctura chloroformi et morphinæ* (Br. Ph.) are intended to replace the same remedy.

[The *emulsum chloroformi* of the U. S. Ph. contains 4 per cent. of chloroform, 6 per cent. of expressed oil of almond, and 1·5 per cent. of tragacanth, with 88·5 per cent. of water. The dose is from 1 to 3 fl. drachms. The *tinctura chloroformi composita* of the Br. Ph. is made with 2 volumes of chloroform, 8 of rectified spirits, and 10 of compound tincture of cardamom. The dose is from 20 to 60 minims.]

The *hypodermic injection* of 5 minims or more of chloroform by a needle thrust deep into the tissues over the nerve often gives marked relief in *sciatica*, and quite recently it has been used for the radical cure of *hydrocele* in place of other irritants. It has the advantage of being a powerful antiseptic.

Inhaled in the form of vapour, chloroform produces by far the most important of all its effects, namely, anæsthesia; a condition of unconsciousness with muscular relaxation and loss of reflex action. It is usual to describe three stages in the production of anæsthesia—stimulation, depression, and narcotism. Practically, it is not always possible to distinguish them. The first stage, that of stimulation, is of very brief duration, and consists of a heightening of all the senses, a mild form of intoxication, which insensibly and rapidly passes into the next, depression, in which there is a gradual numbing and fading out of them all, often accompanied by struggling. Thus the second has been called the struggling stage, as it was at first supposed to be a direct effect of the drug upon the cerebral cortex, but there now seems to be no doubt that it is the conscious or unconscious effort of the individual, in a stupefied state, to fight against some of the symptoms produced by its administration. The most frequent of these is spasm of the glottis from the irritating effects of too highly concentrated vapour, and where the drug is given very cautiously, in

weak, delicate persons, or in those whose whole attention is directed to other more immediate interests, as during parturition, the second may pass into the third stage without any resistance. Once the third stage, that of narcotism or general anæsthesia, is reached, further absorption of the drug kills by paralyzing the respiratory centre in the medulla oblongata.

The exact physiology of chloroform anæsthesia is still a matter of discussion; all observers, however, agree that it always causes a marked fall in the blood pressure with slowing of the heart beat, and slowing and finally cessation of the respirations, after a sufficiently large dose has been administered. This fall in blood-pressure has been variously explained as due either to vaso-motor paralysis produced centrally, or to weakening of the heart's action. Probably both factors play a part in producing it, but the latter is the main one and the most to be feared, the drug acting as a direct poison to the heart muscle. Experiments upon the lower animals show conclusively that where chloroform is pushed to a fatal issue in them, death ensues through paralysis of the respiratory centre. On the other hand, in a large majority of fatal cases in human beings reported from time to time the heart has stopped first, and in many instances respiratory efforts have been noted for some minutes after it had ceased to beat. The best view to take of the case at the present writing seems to be that chloroform, when given in poisonous doses, usually kills by paralyzing the respiratory centre, but that it has a direct toxic effect upon the heart muscle itself, and under certain conditions not at present understood this action is sufficiently strong to cause death before a large enough dose has been absorbed to destroy life in the usual way. In these latter cases the heart is found post mortem dilated and its cavities filled with fluid blood. Failure of the heart, when occurring in this way, may be gradual; but oftener it stops suddenly, without warning, and resists every attempt at resuscitation. General fatty degeneration has been noted after long-continued chloroform administration.

Before giving chloroform for the production of anæsthesia, special care should be devoted to the proper *preparation of the patient*, as the risk attending every case is much increased by neglecting a few easily carried out precautions. All solid food should be withheld for at least five hours previous to the administration; and, except in cases of emergency, the non-compliance with this rule should be considered sufficient cause to forbid the operation. The reason for this rule is that vomiting occurs in many cases during anæsthesia sufficiently deep to render the laryngeal mucous membrane quite insensitive to the presence of foreign bodies, and thus the deep inspirations which follow temporary cessation of breathing during retching may draw the vomited matters into the larynx and cause suffocation. In this connection it is well to remember that milk must be considered a solid food, as it often forms in the stomach a tough mass of curd of considerable size. The state of high nervous tension which often exists in a person about to undergo a serious operation may, too, cause the process of digestion to be entirely suspended, and food which ordinarily would have left the stomach within two hours may be found to have lain for double that length of time without having even been altered in appearance. As far as possible, all fear of the operation should be removed and mental excitement allayed, and where the dread of the anæsthetic is unduly great a hypodermic of $\frac{1}{4}$ of a grain of morphine sulphate may be given half an hour before beginning the inhalation. Everything tending to add to the patient's fears, such as a display of instruments or discussion of the details of the operation before him, should be rigorously avoided. The anæsthetic should always, if at all possible, be given in a quiet room other than that in which the operation is to be performed; where the operating table itself is the only available place, all noises of preparation should be hushed and the room kept absolutely quiet until the patient is quite unconscious. Above all, the practice of beginning to wash up the patient as soon as the inhaler has been placed upon the face is to be strictly forbidden. The anæsthetist alone is responsible for the patient's condition and has the right to demand from the surgeon compliance with all procedures which tend to lessen the risk of accident. Artificial teeth, when they are not securely fixed in the mouth, should be removed, and all sharp brooches, pins, and ornaments for the hair taken off. With regard to the time of day most favourable for operations, practical experience seems to show that patients bear anæsthetics better in the early morning after a night's fast. It is well in chloroforming adult males to have one or two assistants within call, as the violent struggles which at times take place are quite beyond the power of one man to control; and in any case it is most important that the chloroformist should not have his attention divided between restraining his patient and his proper duties. The anæsthetist should be equipped with a drop bottle to hold the chloroform; one of the long, old-fashioned sponge holders with split-wire end and sliding ring, fitted with a folded piece of gauze or small round sponge of close texture; a tongue-forceps; two small pieces of soft-rubber tubing of about the size of a No. 12 catheter; a hypodermic syringe; and tablets of strychnine, atropine, and morphine.

Concerning the *method of administration* opinions differ widely, but that of gradually increasing the strength of vapour from zero up to the amount necessary to produce the required effect is not only the safest but the most scientific. Use the simplest apparatus possible; a folded handkerchief or towel, an open cone or cap with a little absorbent cotton stitched into the apex, or a piece of gauze stretched over a wire framework, answers equally well. Always have the patient in the recumbent posture and with the clothing arranged so that there is perfect freedom of respiration. Put a few drops of chloroform on the towel and cautiously bring

it near enough to the patient's face to allow him to breathe the vapour well diluted at first. If it is well borne, and the respirations are free and quiet, and no symptoms of irritation of the respiratory mucous membrane occur, keep adding a few drops at a time, in such a manner that the vapour given off does not materially alter in strength, until loss of the corneal reflex and muscular relaxation show full anæsthesia to be present. If coughing occurs or holding the breath, it is evidence that the vapour is being given too highly concentrated, and it should be at once withdrawn entirely and the administration cautiously begun again, using less than formerly. Struggling in the vast majority of cases is due to this irritating effect of the vapour, and care exercised in the prevention of the latter will prevent the former. When it does occur, the towel should be moved farther away from the patient's face, not only to lessen the laryngeal irritation, but because from the increased rate and depth of the breathing at the time an overdose may be given. As soon as the signs of anæsthesia are complete, remove the towel from the patient's face altogether for a few moments; the residue of chloroform remaining in the lungs will cause the anæsthesia to deepen still more. Then keep up the condition by the addition of a few drops of chloroform to the towel from time to time as required.

During full anæsthesia—that is, the condition under which surgical operations can be safely performed—there should be deep, steady breathing; a slow, regular pulse (generally about 60 a minute); moderately contracted pupils; and general muscular relaxation with abolition of the corneal, cutaneous, and tendon reflexes. There is a wide difference of opinion with regard to the mode of death in fatal accidents from chloroform administration. The Hyderabad Commission, after making numerous and very elaborate experiments upon dogs, maintain that it is always through paralysis of the respiratory centre, whereas clinical evidence points to the heart rather than the respiration as the primary cause in most cases. An analysis of the fatal cases reported from time to time shows that both pulse and respiration are credited with failing first, but the former more frequently. It is difficult to estimate the value of observations of the kind usually recorded in medical journals regarding deaths from chloroform. Few deaths occur in the practice of any one anæsthetist, and until such an accident does happen, but little attention is paid, it is to be feared, by the majority of persons who administer chloroform, to systematic observation of the patient's condition through the pulse and respiration. With regular, deep breathing, the repeated addition of a few drops of chloroform to the towel is sufficient to keep up the state of anæsthesia. Sighing is evidence that the patient is getting too much, and is to be considered a danger signal, calling for an entire cessation of the administration for a few moments. Rapid breathing may occur from two causes: first, return of cutaneous sensibility; second, deep reflex during full anæsthesia. If the first, partial return of the cutaneous sensibility, is the cause, more chloroform is required; but great care must be exercised in checking it at the proper moment. If the second, the reflexes are produced by certain manipulations on the part of the surgeon. They occur under full surgical anæsthesia during operations which involve stretching of the sphincter ani, working with the mucous membrane of the rectum, compression of the testes or ovaries, rough handling of the peritonæum, and, above all, breaking down of old peritoneal adhesions. They cause, in varying degree according to the personal equation of the individual, either simply increased rapidity of the breathing, increase of both depth and rate with laryngeal stridor, or more rarely complete arrest of the respiration from a marked degree of laryngeal spasm. Notwithstanding this pronounced effect upon the respiration, the pupils and pulse-rate are not disturbed in the least, except indirectly, when the quickened respiration is kept up for some time. During their production no chloroform should be given, as with the increased rate of breathing an increased dose would be absorbed. Pushing the chloroform, from falsely attributing the quickened respiration to partial recovery of the patient, would necessarily lead to a dangerous overdose being administered. Where the pulse shows any signs of weakness, stimulants should be given hypodermically—either from 20 to 60 minims of brandy or, better, $\frac{1}{30}$ of a grain of strychnine sulphate, repeating the dose every fifteen or twenty minutes if the symptom persists. The pupils, when the full effect of the chloroform has been obtained, should be moderately contracted and remain so; the light reflex is not entirely lost, but is often very slow. Dilatation may mean either that the effect of the drug is beginning to pass off or that too much is being given; sudden wide dilatation is a very bad sign and in many cases means that the patient is beyond recovery.

All *deaths under chloroform* are not necessarily deaths from the poisonous action of chloroform. It has been shown beyond question that death may occur from fright, and in several well-authenticated fatal cases, where not more than 5 or 10 minims of the drug had been inhaled, this was probably the true cause, although reflex arrest of the heart, from irritation of the mucous membrane in the nose and larynx, has been urged in explanation. Another cause assigned for death during the first and second stages is interference with the respiration, spasm of the larynx preventing the ingress and egress of air. Such a condition is not uncommon, but it is extremely improbable that it is ever sufficiently severe or sufficiently prolonged to cause death by suffocation. Where the air passes freely through the rima, inspiration may become impossible by reason of the alæ nasi, during the muscular relaxation of the third stage, collapsing like a curtain valve and completely closing the nostrils. To relieve spasm of the larynx, the anæsthetist stands behind the patient and grasps the head so that the palms of his hands cover the patient's ears, and his index fingers lie behind

the angles of the patient's lower jaw. He then lifts the lower jaw up by his fingers in such a manner as to close the patient's mouth and partially dislocate his lower jaw forward, and at the same time makes extreme extension of the neck by bending the head backward. This procedure never fails to give relief, and is much more effectual than grasping the tongue with a forceps and pulling it out of the mouth, as is generally recommended. Closure of the nostrils is easily relieved by inserting two short pieces of soft-rubber tubing of the proper calibre.

Syncope, brought about by the direct action of chloroform itself, may be a cause of death even during the first and second stages; here it must act directly upon the cardiac muscle. During the operation—*i. e.*, during full anæsthesia—accidents are attributed to shock, syncope, and respiratory failure. The first has always been given a prominent position, although it is difficult to conceive of nervous shock occurring during the complete abolition of all but the one set of reflexes such as we know the state of full anæsthesia produces. Hæmorrhage and fall in the body temperature are the only causes which can produce it, provided the narcotism is deep enough to destroy the sensory reflexes. It is noteworthy that the cases in which it has been considered to have caused the fatal issue have been precisely those in which the respiratory reflexes already alluded to occur, namely, operations upon the anus, prepuce, rectum, etc., and, as the reflexes thus produced are liable to be mistaken for returning consciousness, and the pulse and general condition are not disturbed by them, the explanation suggests itself that an overdose, given in the attempt to quiet these reflexes, and not shock, has been the cause of death. For the two other causes chloroform must be held directly responsible, as already stated in discussing its physiological action. The question then arises as to which source, pulse or respiration, the anæsthetist is to look to for the first indication of coming danger. It is impossible in most instances for one man to follow both carefully and at the same time take an occasional look at the state of the pupils, as one is advised in most text-books. The Hyderabad Commission, believing that the respiration invariably fails first, consider that it alone should receive attention. Others, again, among whom are included almost all the leading anæsthetists of the present day, depend upon the pulse as the more frequent indicator of trouble. For several reasons it is best to watch the pulse carefully, if possible by keeping a finger on the radial as the artery in which we are most accustomed to judge of both rate and volume. Failing this, the temporal artery can always be used, and a little practice soon renders the detection of small differences in volume comparatively easy here too. No doubt in the human being as well as in lower animals death from respiratory paralysis due to an overdose of chloroform is occasionally met with, and numerous accidents in which a fatal result is averted by proper treatment follow its administration by careless or incompetent persons. Failure or cessation of the breathing can not help but become evident to the careful chloroformist even while his attention is mainly directed to the pulse, and if it should occur, he has the power of producing respiration artificially, whereas when once the heart has ceased to beat he has no artificial means of driving on the blood current.

When an accident does happen, *methods of resuscitation* should be practised without delay. Those of most value are artificial respiration, inversion, and the hypodermic injection of strychnine. Artificial respiration and inversion are well combined in the manner described by Kelly: "On the first indication of failing respiration the administration of the anæsthetic should be instantly suspended and the wound protected by a fold of gauze. An assistant steps upon the table and takes one of the patient's knees under each arm and thus raises the body from the table until it rests upon the shoulders. The anæsthetizer in the meanwhile has brought the head to the edge of the table, where it hangs extended and slightly inclined forward. The patient's clothing is pulled down under the armpits, completely baring the abdomen and chest. The operator, standing at the head, institutes respiratory movements as follows: Inspiration, by placing the open hands on each side of the chest posteriorly over the lower ribs, and drawing the chest well forward and outward, holding it thus for about two seconds; expiration, reversing the movement by replacing the hands on the front of the chest over the lower ribs and pushing backward and inward, at the same time compressing the chest. The success of the manœuvre should be demonstrated by the audible rush of the air in and out of the chest." Another form of artificial respiration may be more suitable in certain cases, but care should always be taken not to work too rapidly; the anæsthetist often loses his head and performs the respiratory movements at double or treble the normal rate, thereby nullifying any gain that may follow his efforts. At the first sign of failure of either pulse or respiration a hypodermic injection of $\frac{1}{30}$ of a grain of strychnine, alone or combined with $\frac{1}{120}$ of a grain of atropine, should be given as a routine matter.

Rhythmic tractions on the tongue at the rate of about twenty to the minute have lately been strongly recommended by French writers in all forms of asphyxia. Sufficient data have not yet been obtained to determine their value, but the procedure is not difficult of performance and should be given a trial in chloroform poisoning. Other methods of resuscitation are: Forcibly and sharply compressing the præcordium to directly stimulate the heart; plunging a needle into the ventricle; dashing cold water in the face; and holding the vapour of amyl nitrite to the nostrils. The two latter depend upon sensory reflexes, and would only be of use before actual cessation of the heart and respiratory movements. Theoretically, stretching of the sphincter ani would also be of value in respiratory failure, and may be tried. In a desperate case all means should be

used and artificial respiration persisted in for an hour before losing all hope.

It is generally stated that the mortality from chloroform is much less in the extremes of life; recent experience, however, must modify this view as regards infancy: the deaths reported within the last five years have included a considerable number of those of children under five years, and two of them were only five months old. Temperature is shown to exert an influence, much fewer deaths relatively to administrations being reported from hot countries. Long experience has shown that chloroform is relatively much safer in the parturient woman than under any other conditions. Here, however, it is not usual to push it to the full narcotic effect. The conditions of disease which strongly contra-indicate chloroform anæsthesia are: Fatty degeneration of the heart, disease of the coronary arteries, and dilatation without compensatory hypertrophy—weak heart, in other words. Valvular disease in itelf is not necessarily a contra-indication except where the lesion is of such a nature that the attendant excitement is likely to be dangerous. Advanced renal disease should be held to forbid all forms of general anæsthesia; the mere presence of albumin in the urine, however, is not to be regarded as likely to cause any untoward after-effects. In many cases in which it is present, and the operation removes the determining cause, it disappears promptly by the following day. Certain operations seem to be especially fraught with danger. They are: Extraction of the teeth, perhaps from the sitting posture being so often used, the removal of post-pharyngeal adenoids, division of the muscles of the eyeball, and operations on the anus, spermatic cord, etc., as already mentioned.

The inhalation of chloroform vapour is of great value also in controlling *convulsions*, of whatever origin, *renal* and *biliary colic*, and *hysterical spasm of the larynx*, also during the second stage of *labour*. It is not necessary in these conditions to produce full surgical anæsthesia. For hysterical spasm of the larynx it is a dangerous drug to use, unless sufficient for a single dose only is given to the patient at one time. Glass pearls inclosed in a little silken bag and containing the desired quantity are a new and very convenient means of administering it. During parturition sufficient chloroform to deaden the sensibility of the soft parts in no way interferes with the pains of labour, and aids rather than retards the progress of the case.

In every case in which anæsthesia of longer than a few minutes' duration is called for, a choice must be made between chloroform, ether, and the two combined. The advantages alleged for chloroform are that it is much more agreeable to take and convenient to administer, no special apparatus being required in order to get the best results; that it is much less irritating to the respiratory mucous membrane, and is thus less apt to cause troublesome secretion of mucus and struggling on the part of the patient; that it is less bulky, less being required to produce the same effect; and that it is non-inflammable. The only point, however, which should have weight in making a choice is that of safety, and here it must be admitted that in a comparison of the relative numbers of fatal cases to administrations ether is seen to have a decided advantage. Putting the matter as favourably for chloroform as possible, including the large number of cases reported from India without a single death, the proportion is about 1 in 4,500 to 1 in 15,000 for ether. Furthermore, careless and ignorant administration of chloroform largely increases the risk attending every exhibition of it, whereas with ether it does not so much add to the danger as to the patient's discomfort. Again, death from chloroform may occur at any time and in several different ways without giving the slightest warning, even during the most skilful and careful administration. Therefore in the majority of cases ether is to be preferred to chloroform, but in the following chloroform answers best: During parturition, in serious pulmonary affections, in individuals with atheromatous vessels or aneurysm, and in hot countries or where no assistance at all can be obtained, and the patient would be unmanageable in the event of a struggle. Various combinations of chloroform and ether are used with the object of overcoming the cardiac depressant action of the former by the marked stimulant effect of the latter. The most popular of these, known as the A. C. E. mixture, contains 1 part of alcohol, 2 parts of chloroform, and 3 parts of ether. It is an excellent anæsthetic, but has not been shown to be as free from danger as ether alone, which it has therefore not replaced.

In conclusion, it can not be too strongly insisted on that chloroform should never be administered for anæsthetic purposes except by a properly trained individual, and that practical training in the administration of anæsthetics ought to form a part of the curriculum in every medical school.

G. Gordon Campbell.

CHLOROL is a fanciful name for a solution of 1 part each of corrosive sublimate, sodium chloride, and hydrochloric acid, and 3 parts of copper sulphate in 1,000 parts of distilled water. It is for external use only, as a disinfectant, and should be diluted largely with water. The copper salt is said to be added for the purpose of causing vomiting in case the solution should be swallowed by accident.

CHLOROPERCHA.—A solution of gutta percha in chloroform (see under Gutta percha).

CHLOROPHENOLS, CHLORPHENOLS.—These are chlorine derivatives of phenol. *Orthochlorophenol*, or *monochlorophenol*, $C_6H_4Cl.OH$, and *parachlorophenol* have been found useful as an application to parts affected with *erysipelas*, in the form of an ointment of from 1 to 3 per cent., rubbed gently upon the inflamed surface for about a minute twice a day. Glycerin solutions of from 5 to 20 per cent. have been used locally in *tubercular and other affections of the larynx*, but the reports

of results are somewhat contradictory. Monochlorophenol has been used also in the form of a spray for inhalation in *pulmonary tuberculosis*, and remarkable benefit from this employment of it has been reported. All the chlorophenols seem to have decided germicidal properties. Parachlorophenol has been used by Elsenberg (*Arch. f. Derm. u. Syph.*, xxviii, 1; *Brit. Med. Jour.*, Jan. 19, 1895 [*Epitome*, p. 17]) as a topical application in *lupus*. If the surface is not ulcerated he rubs it vigorously and repeatedly with cotton soaked in parachlorophenol, and then applies an ointment of equal parts of parachlorophenol, lanolin, vaseline, and starch. After ten or twelve hours the ointment is removed and the part is painted with an ointment of salicylic acid or iodoform. After a few applications of this succession of remedies, at intervals of two days, slow improvement is usually seen. The treatment is somewhat painful and apt to induce inflammation.

CHOLAGOGUES are drugs which are thought to act as stimulants to the liver, producing an increased flow of bile. The hepatic chemistry is so little understood, however, and so defiant of investigation, the activity of the liver is so closely connected with the activity of the small intestine, and the effects of drugs npon it are so open to confusion and error in observation, that cholagogues are such rather by belief than by proof. In deficiency of bile secretion we, of course, give certain remedies that we expect will act as hepatic stimulants, and these we call cholagogues, but our reasons for doing so are rather that experience has taught us that their use is followed by an amelioration of symptoms and an increased amount of bile in the dejections than that these effects are proved to depend upon any power the drugs exert upon the liver itself. Our knowledge of cholagogues, therefore, is mainly clinical and empirical. Experimental investigation of the subject is not wanting, it is true, but it is beset with so many difficulties and attended with so many contradictions that, with the exception of some few agents for whose cholagogue power clinical evidence is already very strong, its results are neither conclusive nor satisfactory. In these experiments it is customary to establish biliary fistulæ in dogs and then to observe the discharge of bile through them as it occurs after the administration of various drugs. To the accuracy of these observations, however, there are the two very valid objections that operative procedures upon the biliary tract can scarcely be expected to preserve the normal and physiological condition in an organ so delicate as the liver, and that the hepatic digestion of the dog appears to differ in no small degree from that of man. The often-quoted experiments of Rutherford are probably better known than others upon this subject, and, though open to the objection raised by Wood of not being sufficiently numerous, as well as to those already mentioned, they are, nevertheless, interesting. According to Rutherford, *podophyllin* and *aloes* produce a great increase in the amount of bile secreted when they are not used in decidedly purgative doses; *euonymin*, *sanguinarine*, and *ipecac* have a great effect upon the production of bile and do not purge: *bichloride of mercury* is cholagogue, while *calomel* is, as concerns the liver, inert; *rhubarb*, *colchicum*, *iridin*, *colocynth*, *jalap*, *sodium phosphate*, *sodium sulphate*, and *sodium and potassium tartrate* increase the flow of bile and also purge; while as cholagogues, *leptandrin*, *sodium chloride*, and *potassium bicarbonate* have a moderate effect; *senna*, *gamboge*, *scammony*, *castor oil*, *magnesium sulphate*, and *ammonium chloride* have little effect, and *croton oil* has none.

From the clinical standpoint, the difficulties which attend the study of cholagogues are as great as those which surround the experimentation. Especially does confusion arise because of the complexity of the relations which exist between cholagogues and purgatives, for most purgatives of violent action produce increased discharge of bile for mechanical reasons; many purgatives, too, have probably, in addition to purgation, a specific action as hepatic stimulants; and all cholagogues pure and simple must necessarily, to some degree, promote catharsis by virtue of the increase in biliary flow from the liver, for bile is itself cathartic. The division of cholagogues, therefore, into two classes is not unnatural, and many authors describe a class of *direct*, or *true*, *cholagogues* and a class of *indirect cholagogues*, or cholagogues by virtue of catharsis. The direct cholagogues are those whose action is exerted directly upon the gall-bladder, bile-ducts, and liver-cells, while the indirect cholagogues are purgatives whose action it is to sweep from the intestine the bile it contains, and thus give occasion for the production of a new supply. Though many writers make this distinction more or less evident, it is Bruce in particular who dwells upon it, and as examples of direct cholagogues he cites *podophyllum*, *rhubarb*, and *sodium sulphate*, while as examples of indirect cholagogues he mentions cathartic drugs and especially the *mercurials*. His examples of direct cholagogues, however, are not well taken, for all three, when given in sufficient doses, are cathartics by virtue of actions quite independent of hepatic stimulation. Probably the best example of a cholagogue pure and simple is offered by *dilute nitro-hydrochloric acid*, though *sodium salicylate* and *bichloride of mercury* are almost equally apt, and *sulphurated antimony*, *arsenous acid*, *the mineral acids*, *the alkalies*, especially *the sodium salts*, and *benzoic acid* might not improperly be classed with them. If, therefore, we take these as drugs devoid of intestinal action other than cholagogue unless given in toxic doses, there remains a large number of drugs intermediate between our pure cholagogues and our indirect cholagogues, or cholagogues by purgation. These also are direct cholagogues because they exert a specific effect in biliary production, and, if they are given in small doses, this is their only intestinal effect, but when the doses are increased there are added other actions as well, catharsis in par-

ticular, and thus they may also become indirect cholagogues or cholagogues by purgation. To this intermediate group belong *ipecac*, *colocynth*, *podophyllum*, *euonymin*, *iridin*, *aloes*, *colchicum*, *jalap*, *scammony*, *rhubarb*, *magnesium sulphate*, *sodium phosphate*, and *sodium sulphocarbolate*.

An interesting contribution to our knowledge of cholagogues has been made by S. Rosenberg, who experimented upon dogs with gall-bladder fistulæ. From him we learn that *olive oil* in large doses is actively cholagogue, that *sodium salicylate* is little less so, that *water* produces a temporary increase in biliary flow, and, *mirabile dictu*, that *Carlsbad water* causes its diminution. These experiments, though interesting and to some degree confirmatory of our clinical knowledge, are nevertheless open to the objections already made against similar experiments—namely, that the natural conditions were not preserved and that what is true of the dog's digestion is not necessarily or probably true of that of man.

The contra-indications to the use of cholagogues are few; practically they are forbidden only by acute inflammations of the liver itself, the gall-bladder, or the gall-ducts, and the indications are also few and covered by the condition of deficiency of bile production or excretion. This deficiency of bile may be the result of a mere functional disturbance of the liver, a condition often vaguely described as "bilious," or it may accompany serious organic changes in that organ, such as cirrhosis, cancer, and fatty and waxy degenerations. The "*bilious*" *condition* is the one in which cholagogues are most frequently employed. Failure of the liver to produce a sufficient quantity of bile is regularly followed by a characteristic train of occurrences. These, according to Delafield, are as follows: Deficient digestion of fats and peptones and consequent malnutrition, the patients losing flesh or, if not that, becoming anæmic and flabby, the decomposition of the intestinal contents with symptoms of intestinal fermentation and possibly those of systemic poisoning from absorption, and finally constipation. The more detailed symptomatology of biliousness includes constipation, with hard and light-coloured fæces, flatulence and abdominal distress, perhaps the occasional occurrence of diarrhœa with irritating and offensive movements, a capricious appetite, a pale, sallow, and muddy skin, headache, a mental condition of dulness, drowsiness, forgetfulness, "nervousness," irritability, neurasthenia, and even melancholia, disturbances of sensation at various portions of the body, pains, or paræsthesiæ, a coated tongue which is apt to be pale, flabby, and tooth-marked, a bitter taste in the mouth, and the urine often pale and large in amount, containing phosphates in abundance and sometimes oxalate of calcium. Bilious vomiting may occasionally occur, sometimes with headache, body pains, and malaise, constituting the condition popularly known as a "bilious attack." These, then, are the symptoms which may be present; they occur, however, in all grades of severity and in various combinations, from those mild cases where constipation and flatulence are about the only ailments to those very severe ones in which the patients suffer from a majority of the symptoms described, even to the degree of becoming melancholic. It is in these conditions that cholagogues find their chief application, at first given freely, subsequently diminished as improvement occurs, and finally withdrawn, the persistence in healthful diet and, above all things, exercise in plenty (for that in itself is cholagogue) accompanying the drug treatment and being continued after its withdrawal, serving to accentuate and to maintain the good effect. Alcohol, too, must be diminished or even stopped entirely, for there seems abundant proof that this drug is actively anticholagogue. Tobacco, also, is usually injurious. Of cholagogues useful in such conditions, Delafield prefers small amounts of magnesium sulphate given in a glass of hot water an hour before meals, or, instead, podophyllum, aloes, rhubarb, ipecac, sodium phosphate, sodium sulphocarbolate, bichloride of mercury, or the mineral acids, given separately or variously combined. If nitro-hydrochloric acid is the cholagogue prescribed, and it is one of the most valuable we possess, care should be had that the freshly combined and deep-red acid is used, for the acid which has been kept long and has become of a lighter colour (even the golden-yellow acid of the U. S. Ph.) is relatively and perhaps wholly inert. This caution is especially emphasized by Wood.—Henry A. Griffin.

CHONDRUS (U. S. Ph.), *carrageen* (Ger. Ph.), *Irish moss*, has been used in decoction as a demulcent in *pectoral affections*, *diarrhœa*, *dysentery*, *gastritis*, and *irritated conditions of the urinary tract*. A solution made by boiling it for ten minutes with 30 parts of water gelatinizes on cooling, and this jelly, being free from starch, constitutes an eligible article of food for the sick when for any reason starchy food is to be avoided.

CHROMIC ACID, *acidum chromicum* (U. S. Ph., Br. Ph., Ger. Ph.), CrO_{3}, occurs in small acicular or rhombic crystals of a dark purplish-red colour, odourless, deliquescent, and very soluble in water. It is obtained by heating neutral potassium chromate to redness in chlorine. It should be kept in glass-stoppered bottles, and great caution should be observed to avoid bringing it in contact with organic substances, such as cork, alcohol, sugar, etc. The acid used medicinally, especially externally, should be free from sulphuric acid in order to avoid its spreading over surrounding healthy tissue.

A solution of chromic acid, *liquor acidi chromici*, is official in the Br. Ph., and is prepared by dissolving 1 part of anhydrous chromic acid in 3 fl. parts of distilled water.

Dr. H. Pander, of Dorpat, found that chromic acid and its salts produced both acute and chronic poisoning when administered internally, and that the acid was a hundred times as poisonous as chromium oxide. In the acute forms of poisoning there are disturbances of the central nervous system

and of respiration. The chronic form affects particularly the skin and the mucous membranes, through which the acid is absorbed; it causes a parenchymatous, followed by an interstitial, nephritis. Locally, it is a powerful escharotic, effecting speedy and complete disorganization of animal tissues; in a pure state it rapidly destroys the capillaries, coagulating their contents and thus preventing its absorption. This power of coagulating albumin, and the readiness with which it parts with its oxygen, oxidizing organic matter and decomposing ammonia and sulphuretted hydrogen, make it a powerful disinfectant and deodorizer. A solution of 1 to 10,000 hinders and one of 1 to 5,000 prevents the development of micro-organisms.

These latter properties are made use of in the manufacture of *chromicized catgut ligatures.* Five parts of No. 0, 1, 2, or 3 catgut are stretched and immersed for twelve hours in a solution of chromic acid, 1 part in 100 parts of distilled water, then the catgut is transferred to 100 parts of sulphurous acid, in which it remains for twelve hours, after which it is taken out and dried.

This acid is rarely, if ever, administered internally. Locally, it is applied either in crystalline form, or mixed with equal parts of water, or made, with great caution, into a paste with glycerin, as an escharotic in *neoplasms of the skin* or *mucous membranes.* It is an excellent application to *condylomata* and other *warty growths*, especially of the genitalia. It may be applied pure to *nævi* and *fungus hæmatodes*, the tumour being first surrounded by a film made by painting on a solution of gutta percha. It has been used pure and in solutions of from 10- to 25-per-cent. strength in the treatment of *lupus*, *carcinoma*, and *malignant ulcers.* In solution, the application is made by means of pointed glass rods, and after the application lead lotion, or a solution of aluminum acetate or sodium bicarbonate, may be applied to remove any superfluous acid. In the treatment of *uterine cancer*, the necrotic shreds should be removed from the cervix and the vaginal wall by means of absorbent cotton, the uterus and vagina irrigated with a hot normal salt solution, and the entire diseased surface cauterized with a solution of chromic acid, 1 part in 3 parts of water. The solution must not come in contact with healthy tissues, and the latter are best protected by painting them with a saturated solution of sodium bicarbonate; after the application, which may be made three times a week, tampon the vagina with iodoform gauze. The discharge and pain decrease, and the appetite and general health are improved.

A solution of from 3- to 10-per-cent. strength is a useful application to *ulcerated gums*, especially those due to cachexia or *mercurialism.* These solutions are also useful as washes in *syphilitic glossitis*, *pharyngitis*, and *laryngitis.* Dr. E. Woakes has reported that a saturated solution of chromic acid, injected or passed by means of a probe into the cyst of a *goître* or *ranula*, after evacuating the fluid contents, produced a rapid cure. In *chronic hypertrophic rhinitis*, *pharyngitis*, and *naso-pharyngeal adenoid vegetations* applications of the pure acid fused on a probe, after preliminary cocaine anæsthesia, produce cicatrization or absorption of tissue. *Sycosis* has been cured by the application of a 10-per-cent. solution. It has been used as an application for the cure of *hæmorrhoids.* A 5- or 10-per-cent. solution, applied daily, will often cure *bromidrosis.* It is an excellent application in *chronic endometritis* and *intra-uterine growths.*

The applications must be made with caution, as poisoning has followed the topical use of the remedy. Sodium borate or bicarbonate will neutralize it, and stimulating hypodermic or rectal injections counteract the toxic symptoms.—Samuel T. Armstrong.

CHRYSAROBIN, the *chrysarobinum* of the pharmacopœias, is a mixture of proximate principles forming the largest and most important constituent of Goa powder (*araroba*, *pulvis ararobæ*), a substance found deposited in large cavities or clefts in the heartwood of *Andira Araroba*, a large papilionaceous tree growing in the province of Bahia, Brazil. Locally the powder is known as *po de Bahia* and the tree as *angelim amargoso.* This powder was formerly exported from Brazil to Portugal, and thence to Portuguese colonies in Africa and Asia. From the Goa settlement on the Malabar coast it found its way into the pharmacy of the East Indies, and subsequently into that of Europe and America, under the name of Goa powder. As found in commerce, it is a rough powder containing irregular pieces and mixed with bits of wood, at first of a bright-yellow colour, becoming afterward, through exposure to light and moisture, of a brownish or purplish colour. In the tropics it has long been held in high repute as a topical remedy for various cutaneous diseases, especially for *ringworm*, and was commonly used in the form of a paste made with water, lemon-juice, or vinegar. It was first introduced to English physicians by Fayrer and da Silva Lima. In 1875 Attfield first extracted the substance for which he proposed the name chrysarobin, and which he supposed to consist chiefly of chrysophanic acid. It constitutes over 80 per cent. of Goa powder, from which it is extracted by hot benzol. In 1878 it was shown by Liebermann and Seidler that this extract was a previously unknown compound, $C_{30}H_{26}O_7$, which, though distinct in character from chrysophanic acid ($C_{15}H_{10}O_4$), was readily converted into it by oxidation.

Chrysarobin is "a pale orange-yellow, crystalline powder, permanent in the air, odourless and tasteless, almost insoluble in water, only slightly soluble in alcohol, readily soluble in ether and in boiling benzol" (U. S. Ph.). Concentrated sulphuric acid dissolves it, as well as a strong solution of caustic potassa. The alkaline solution rapidly absorbs oxygen from the air, and chrysophanic acid is formed. It was ascertained by Lewin and Rosenthal from experiments on animals that oxidation of chrysarobin took place also in the body. By the same investigators it was further shown that the

drug might be absorbed through the sound skin when applied as an ointment, appearing in the urine as chrysophanic acid, and when the inunctions were continued for some time the animal showed symptoms of renal disease and perished. In the human subject, however, renal complications have rarely been observed even after prolonged applications of the remedy.

When applied to the skin, chrysarobin sooner or later causes a superficial erythema, which, if the applications are continued, may become a severe and painful dermatitis. Papular, pustular, or even erysipelatous inflammation may be produced. Especially on the face and in the region of the genitals is such severe inflammation apt to occur. The face becomes swollen, the eyelids are puffy, and the eyes are inflamed, while about the genitals an intense and intractable form of eczema may be produced. The dermatitis often extends beyond the area to which the drug has been applied, and is frequently observed on the face when applications have only been made to the trunk and extremities. The facial inflammation is always accompanied with conjunctivitis that is attended with much photophobia and congestion, though generally without much secretion. In severe cases the ocular conjunctiva may show a deep-red coloration. Not infrequently it happens that a conjunctivitis occurs independently of any inflammation of the skin of the face, due apparently to rubbing the eyes with fingers soiled with the drug. Sometimes but one eye is affected. It is said that the upper lid is less liable to the inflammation than the lower lid and the bulbar conjunctiva.

Another disagreeable feature attending the external use of chrysarobin is the staining of the skin and clothing. Dirty-brown indelible stains are produced in the underclothing and bed linen. The skin surfaces treated become at first of a reddish-brown colour, afterward of a dusky-brown, which only disappears with gradual exfoliation of the cuticle. The nails acquire a deep mahogany hue, and if the drug has been applied to the scalp the hair, especially when light coloured, is stained dark. It is a curious fact that when *psoriasis* is treated with chrysarobin the scaly patches remain unaffected by the pigment, so that after the disease has been healed by the remedy the spots previously the seat of psoriasis remain pale, in striking contrast to the dusky-brown hue of the surrounding skin.

Though chrysarobin has been used in small doses internally, it is seldom if ever thus employed now, owing to its intense irritant effect on the stomach. Its use is practically limited to the external treatment of certain cutaneous diseases, for one of which at least—namely, *psoriasis*—it is pretty generally regarded as the remedy *par excellence.* It is used also with considerable success in other affections attended with abnormal growth of the epidermis, as well as in *parasitic diseases of the skin*, more particularly those due to hyphomycetic parasites. Some authorities have, however, put in question its germicide virtues. Thus, Marianelli, of Pisa, found, after very thorough treatment of ringworm of the scalp with chrysarobin ointment, that the trichophyton was still living and could be successfully cultivated in the usual media. Campana treated *Sarcina lutea*, *Staphylococcus pyogenes aureus*, black and red ferment, etc., with chrysarobin in powder and in ethereal or watery solutions, without any effect being produced upon the course of development of these organisms.

Chemically, chrysarobin is a strong reducing agent, and upon this property is supposed chiefly to depend its therapeutic action in many cutaneous diseases in which cornification is defective. In the process of cornification a deoxidation of the epidermic cells is said to be essential, and hence the indication for a reducing agent.

It may be used in the form of an ointment (from 5 to 10 per cent.) in vaseline or vaseline and lanolin, in plaster, in the mull applications of Unna, in a superfatted soap, in collodion, in liquor gutta perchæ, in plasment (a proprietary jelly-like substance made from Iceland moss), or in a paste made from bassorin (the so-called bassorin paste of Elliot). None of these preparations is wholly free from objection on the score of staining the skin and clothing. The ointment is perhaps the most objectionable of all in this respect, but, on the other hand, no preparation appears to be quite so efficacious as a chrysarobin ointment well rubbed in. The *unguentum chrysarobini* of the U. S. Ph. contains 5 per cent., and that of the Br. Ph. 4 per cent. of chrysarobin in benzoinated lard. The drug should never be applied to the face or to the genitals. When it is used upon the scalp, great care should be taken to limit its action to the seat of disease by means of impermeable dressings. Whenever it is applied the effect should be closely watched, and the use of the drug suspended as soon as the skin begins to show signs of inflammation. EDWARD B. BRONSON.

CHRYSOPHANIC ACID.—See CHRYSAROBIN.

CICATRIZANTS.—See VULNERARIES.

CICUTA is a name formerly given to *Conium maculatum*, but now applied to several plants, particularly *Cicuta maculata* and *Cicuta virosa.* Cicuta is not official.

Cicuta maculata, spotted cowbane, musquash root, beaver poison, American water hemlock, wild parsnip, resembles the European variety, and is found throughout the United States, growing in damp places and on the banks of streams. Its action is almost identical with that of *Cicuta virosa.* Its root is its most poisonous portion and somewhat resembles that of the parsnip in taste and smell. This resemblance to the parsnip has been the cause of the poisoning of children, cicuta having been mistaken for parsnip and eaten.

Cicuta virosa, cowbane, poison turnip, water hemlock, is a perennial European plant which grows in wet, marshy places, and especially along the borders of streams. It is exceedingly poisonous to animals as well as to man, though it has been said that some few animals

enjoy immunity. To man the plant is a violent poison, but its activity is said to be somewhat lessened by drying. Its action is that of an acro-narcotic poison, resembling that of conium. The symptoms produced by it are gastric irritation, dizziness, inco-ordination, convulsions, stupor, and general paralysis, ending in death, though vomiting often occurs and serves to diminish the symptoms of poisoning. The active principle is said to be an amorphous substance of slight odour and very offensive taste. To this substance the name of *cicutoxin* has been given. There has also been described a volatile alkaloid occurring in the plant, called *cicutine*, the *cicutina* of the Fr. Cod.

The physiological actions and therapeutic effects of both these varieties of cicuta strongly resemble those of conium, and this has led to their employment as substitutes for that drug. *Cicuta maculata*, in particular, has been so employed, and its effect in *migraine* and in *nervous headache* has been thought excellent. The internal administration of cicuta has now been entirely abandoned, however, and its only use in medicine is its rare application in the form of an anodyne poultice for *local pains*, especially those of *rheumatism*. *Cicuta virosa* has thus an occasional employment. This disuse of cicuta is certainly wise and justified, for, while its powers are almost identical with those of conium, it possesses no advantages whatsoever over that drug, and its toxicity is even more to be feared than that of conium, from the fact that its powers have been less studied and are therefore less known. In poisoning by cicuta the stomach should be thoroughly emptied and stimulants freely employed. There is said to be some antidotal efficacy in an infusion of galls.

Henry A. Griffin.

CIGARETTES, CIGARS.—Medicinal substances are occasionally prescribed in the form of cigarettes or cigars, to be smoked as a rapid way of introducing their volatile principles into the circulation through the lungs or for their topical action on the upper air-passages. They are chiefly stramonium, tobacco, hyoscyamus, cubeb, belladonna, Indian hemp, digitalis, and eucalyptus.

CIMICIFUGA (U. S. Ph.), *cimicifugæ rhizoma* (Br. Ph.), is the rhizome and rootlets of *Cimicifuga* (or *Actæa*) *racemosa*, a perennial herb found in the United States and Canada, popularly known as black snakeroot or black cohosh, and held in high repute by the aborigines for its abortifacient and ecbolic properties. In large doses it may cause vertigo, frontal headache, amblyopia, dilated pupils, a weak action of the heart, and nausea. In moderate doses it is diuretic, increases the bronchial and cutaneous secretions, and may be regarded as a mild bitter tonic; as such, however, it is rarely used. Its effects upon involuntary muscular fibre very closely resemble those of ergot, for which it may be substituted in obstetrical practice where the latter is not at hand. In some cases of labour, indeed, it appears to act more favourably than ergot, as the uterine contractions caused by it are rather more like the natural ones. In *post-partum hæmorrhage* it may be used, but, as a rule, it is not so reliable as ergot. *Amenorrhœa* and *dysmenorrhœa* of the congestive type are both benefited by it, also the variety of uncomfortable symptoms, such as *headache, flushing of the face, nervousness*, etc., due to *delayed* or *arrested menstruation*. In some cases of *subinvolution of the uterus* and *uterine fibroids* it has been employed with success, but in such cases the results are better if it is combined with ergot. In *spermatorrhœa* unaccompanied by congestion it is very useful, and on account of its property of increasing pelvic congestion it is efficacious in functional *impotence* in which the erections are imperfect and the testicles unduly soft. As a substitue for digitalis it has been used in *fevers*, and in *weak* and *fatty heart*, but is, as a rule, not so efficient, except in the latter condition, in which it has sometimes been more effectual. As an expectorant, combined with small amounts of opium, it has been used with considerable success in *bronchial catarrh* and *caseous pneumonia*. Sometimes when everything else fails it will relieve the tremors and restlessness of *delirium tremens*, at the same time giving tone to the stomach on account of its bitter properties. Some authorities regard it as being almost the best remedy for *chorea*, especially when the disease is dependent upon *uterine trouble* or *rheumatic taint*. *Acute rheumatism* itself has been treated successfully with this remedy alone, but it is hardly to be relied upon in this disease, for which so many more efficient remedies exist. All forms of *neuralgic* or *muscular pains*, such as *lumbago, pleurodynia, wry-neck*, etc., especially when associated with a rheumatic history or with menstrual disorders, are pretty sure to be relieved by its administration.

Whenever this drug is used it must be given in such quantities as to cause slight cerebral disturbance and all preparations must be made from the fresh drug. The fluid extract, *extractum cimicifugæ fluidum* (U. S. Ph.), and the liquid extract, *extractum cimicifugæ liquidum* (Br. Ph.), are the best preparations. The dose of each is from 1 to 2 fl. drachms. The dose of the *tinctura cimicifugæ* of the U. S. Ph., also of that of the Br. Ph., is from 15 to 60 drops. The dose of the *extractum cimicifugæ* of the U. S. Ph. is from 1 to 6 grains. *Cimicifugin*, or *macrotin*, a resinous body precipitated from a tincture by the addition of water, is used by the eclectics in doses of from 1 to 2 grains. The plant is said to contain also an alkaloid, *cimicifugine*.

Russell H. Nevins.

CINCHONA (U. S. Ph.), *cinchonæ cortex* (Br. Ph.), *cortex chinæ* (Ger. Ph.), Peruvian bark, Jesuit's bark, is the dried bark of various species of *Cinchona*, from which its peculiar alkaloids may be obtained. The U. S. Ph. rejects all barks which yield less than 5 per cent. of total alkaloids, and furthermore requires the official barks to contain at least 2·5 per cent. of quinine. No quantitative requirements are

made by the Br. Ph. The name cinchona is an incorrect spelling of the proper name Chinchon, for it was given to the bark in honour of the Countess of Chinchon, the wife of a viceroy of Peru, who herself was saved by its use and who is said to have introduced the bark into Europe. The trees from which the bark is obtained are native to South America and grow in its western portions, especially upon the slopes of the Andes, at an elevation of between five and ten thousand feet, and throughout an area extending from the nineteenth degree of south latitude to about the tenth degree of north latitude. Though found wild exclusively in South America, the cinchona trees have in recent years been cultivated extensively, not only in South America, but in other parts of the world as well, and especially in Java, in India, in Ceylon, and to some extent in Jamaica. The cultivation in Java has been particularly successful, and the amount of bark exported is steadily increasing. The bark of the cultivated South American trees is far richer in alkaloids than that of the wild trees, and, singularly enough, the cultivation of the trees in countries other than their natural home has resulted in the production of barks vastly superior to the South American barks in alkaloidal percentage; moreover, species relatively poor in South America have become by transplantation and cultivation elsewhere producers of remarkably rich and valuable barks. To such an extent has this successful foreign cultivation gone that but 5 per cent. of the world's supply came from South America in the year 1890, though originally the bark had not been obtainable elsewhere, and of this a very small amount was from wild trees. Cultivation has therefore resulted in a wonderful enriching of cinchona bark in alkaloid value, and especially cultivation abroad. Though the genus *Cinchona* contains a number of species which yield barks containing the alkaloids in some amount, few are sufficiently rich in them to be cultivated profitably, and the supply at present is almost entirely derived from *Cinchona Calisaya*, *Cinchona succirubra*, and *Cinchona officinalis*, together with their hybrids, for the mingling of species has been found highly advantageous.

Cinchona flava, yellow bark, calisaya bark, is obtained from *Cinchona Calisaya*, and almost invariably from cultivated trees. In commerce it is found in flat pieces as well as in quills, and its powder is of a pronounced yellow and even of an orange colour. It is the richest of the barks in quinine, which constitutes three quarters of its total alkaloids. As compared with the other barks, cinchona flava is less astringent and considerably more bitter.

Cinchona rubra (U. S. Ph.), *cinchonæ rubræ cortex* (Br. Ph.), *cortex chinæ* (Ger. Ph.), red cinchona bark, is obtained from *Cinchona succirubra*, generally of the cultivated variety, the Br. Ph. requiring that the bark used be from cultivated plants, while the U. S. Ph. demands 5 per cent. of total alkaloids. This bark contains a large amount of alkaloids, but of these the quinine amounts to but about one fifth. In the market it is found in quills and flat pieces and the colour of its powder is reddish brown.

Pale bark, crown bark, Loxa or Loja bark, is obtained from *Cinchona officinalis*, both wild and cultivated. The cultivated variety is especially plentiful in India, and the wild bark is gathered in South America, particularly in the neighbourhood of Loxa, Ecuador. The amount of quinine is from two thirds to three quarters of the total alkaloids, but in these the bark is not rich. The bark in commerce comes in rolls and quills. Its powder is of a pale fawn colour.

Besides these there have been and still are a number of inferior barks in the market which, though in no way comparable in value to those just described, are nevertheless sources from which the alkaloids may be derived. Many of them formerly came from the northern portions of South America, and among them the so-called Cartagena barks, while at the present time there are collected in Colombia and from uncultivated trees barks which, though low in alkaloidal value, are yet of service in the manufacture of preparations of which the value is rather in bitterness than in the amount of quinine contained in them. To this latter variety is generally given the name of Maracaibo bark, and beyond it there is at present little or none of the inferior wild bark collected for the market, the cultivated barks having, for the reasons already given, supplanted those of natural origin.

The cinchona barks were formerly grouped according to their appearances, and especially by their colour or the colour of their powders, and much time and study were devoted to their classification, but latterly the improving influences of transplantation and cultivation have effected such changes in their quality, and, moreover, the present method of rating them by assay has provided such an accurate means of determining their value, that botanical classification has become of comparatively little commercial importance, and to-day it makes little or no difference whether the specimen presented is yellow bark, red bark, or pale bark, provided only it is cinchona and furnishes the required percentage of alkaloids and of quinine. Of these alkaloids peculiar to the cinchona barks and their active principles there are a number, thirty-two natural ones having received recognition up to 1893, besides seven prepared artificially. None of the artificial alkaloids are recognised by the pharmacopœias, and of the natural ones but four are official—quinina (quinine), quinidina (quinidine), cinchonina (cinchonine), and cinchonidina (cinchonidine). These four alkaloids are found in cinchona in quantities which vary with the species of the bark, quinine being most abundant in the yellow bark, cinchonine predominating in the pale bark, and the red bark containing approximately equal amounts of quinine and cinchonine. As for quinidine and cinchonidine, they are most plentiful in the pale and Cartagena barks. These alkaloids occur in the barks in combination with an acid to which the name kinic has been given. Besides these ingredients, there are in cinchona

tannic acid, or, more exactly speaking, its modification, cinchotannic acid, kinovic acid, colouring matter, starch, fatty matter, a volatile oil to which the odour of the bark is due, and quinovin, kinovin, or chinovin, a bitter principle. Of the four alkaloids, quinine and quinidine have the same formula, $C_{20}H_{24}N_2O_2$, and of cinchonine and cinchonidine the same thing is true, their formula being $C_{19}H_{22}N_2O$. A peculiar result follows the application of heat to these alkaloids, for quinine and quinidine are changed to a new alkaloid, quinicine, which, however, has the same formula as its antecedents. In like manner, cinchonine and cinchonidine, when heated, are changed into their isomeric modification, cinchonicine. These transformations take place to some degree in the process of extracting the alkaloids from the bark, but it is not probable that the modified alkaloids exist in the bark in its natural state.

The physiological actions of cinchona and its official alkaloids vary among themselves in degree only; in kind they are identical. No advantage would therefore result from their separate consideration, and it is consequently my purpose to present the actions and uses of that one of them most commonly employed, quinine, and subsequently, while speaking of their administration, to point out the differences of action and utility which may exist between the various alkaloids and preparations and the type as represented by quinine.

Locally applied, quinine and its salts are irritants to excoriated surfaces and to mucous membranes. They also exert a considerable antiseptic effect, the application of cinchona bark in powder or its alkaloids to *unhealthy wounds* being followed by a lessening of putrefaction and an acceleration of healing. It is only upon the feebler micro-organisms, however, that this power is pronounced; the stronger ones resist destruction, though inhibition of growth ordinarily results. Of all the cinchona alkaloids, quinine is the most effective in antiseptic action. It is highly destructive to the fungi which cause fermentation, and the preservation of meats, milk, butter, albumin, and urine may be accomplished by the addition of quinine to them in the proportion of one part in three hundred. In the same way the alcoholic fermentation of saccharine material is prevented. These effects, though of considerable duration, are not permanent, however, and solutions of quinine salts themselves will in time be found to contain fungi. These actions of quinine salts are seldom evoked in medical practice, for their advantages are scarcely comparable to those of other applications, but in a few of the skin diseases which depend upon the action of fungi these salts are considerably employed.

Upon the stomach the cinchona alkaloids act as simple bitters, increasing appetite and the production of gastric juice and promoting digestion. Their long-continued action has the usual effect of bitters when so employed—that of causing chronic gastric catarrh; and their irritant action is seen in the production of nausea and vomiting and occasionally of diarrhœa following their administration in overdoses. For this reason the prohibition of bitters in acute gastric and intestinal inflammations is especially necessary in the case of quinine. The action of cinchona itself upon the digestive tract is that of its alkaloids, with the additional quality of astringency dependent upon the tannic acid it contains. Cinchona is therefore to be classed among the astringent bitters and a constipating tendency attributed to it, though, as is the case with its alkaloids, diarrhœa may follow its continued use or its employment where intestinal irritability exists. The largest amount of tannin is contained in the red bark.

The cinchona alkaloids are soluble in solutions of the mineral acids, and therefore, whatever the form of administration, are taken up by the gastric juice and rapidly absorbed by the blood, those portions which escape gastric absorption being precipitated by the alkaline secretions of the intestine and voided. Though they are precipitated in alkaline media, this does not take place in the blood, the carbonic acid in that fluid serving to maintain the solution. Upon the blood the effect of quinine is pronounced, and, though the matter has been much discussed and the statement much disputed, it is probable that by its action the number of white corpuscles is diminished and their emigration stopped. Moreover, the oxygen-carrying capacity of the red blood-corpuscles seems undoubtedly to be diminished by quinine, a fact which some have thought explanatory of the antipyretic action of the drug. The effect of small therapeutic doses of quinine is to slightly accelerate the heart's action, but very large doses exert upon it a pronounced sedation, the rate usually becoming considerably slower and the contractions less forcible. These results are apparently due to a direct action either upon the myocardium or upon the cardiac ganglia. The blood-pressure is lowered by the administration of very large doses of quinine. While a portion of the diminution is doubtless a result of the less powerful contractions of the heart, there seems no doubt that it is largely brought about by a direct action of the drug upon the vessels themselves.

Considerable antipyretic power is possessed by quinine. In health the temperature is not at all diminished by small doses and but very slightly by large ones, but in febrile diseases there occurs from its employment a considerable lessening of temperature. How this result is brought about is not understood, but circulatory sedation may assist in its production and possibly diminution of oxidation.

The action of quinine upon the uterus is interesting and important. It was formerly taught that the administration of quinine to pregnant women was hazardous, for it was believed that the drug had the power to originate uterine contractions of sufficient violence to bring on abortion. This belief, however, is contradicted by an abundance of testimony, both clinical and experimental, and as malarial disease, the condition in which quinine is so frequently employed, is beyond doubt a frequent cause of abortion, it appears evident that

the remedy has been the innocent recipient of the blame which should have been borne by the disease. Furthermore, there can be but little doubt that quinine, administered to those infected with malarial disease and in whom abortion is impending, may act to prevent its occurrence. As a result of a considerable experience in India, Dymock is of the opinion that quinine is possessed of little initial oxytocic power, and concludes that it may be given in large doses to pregnant women who are suffering from malarial disease and without producing abortion. If quinine is given in labour, however, it certainly is energetic in stimulating uterine contractions, but this is probably due rather to its action as a systemic nerve tonic than to any direct effect produced upon the uterus. Its action, too, as an emmenagogue must be explained in the same way.

Quinine has been detected in almost all the secretions, but it is in the urine that its main elimination takes place. Its appearance in the urine rapidly follows its administration, and after a large dose given by the mouth it is said to have been found in that fluid in half an hour, while ten minutes after its hypodermic injection the same thing took place. The complete elimination, however, is a slower process, but Wood is of the opinion that if but few doses have been taken it is excreted within two days, though a portion of it may be discovered in the urine for a considerably longer time if the administration has been prolonged, if there is renal disease, or if the circulation is feeble. The effect of quinine upon the urine is a pronounced one, for by its employment in considerable doses there is produced a marked diminution of all the nitrogenous constituents, especially uric acid, and there is good reason to believe that this is not due to nitrogenous retention, but to diminution of tissue change throughout the body. The drug leaves the body mainly unchanged in form, though to some extent also as quinicine. An occasional though rare result of its elimination is the occurrence of renal and vesical irritation.

Though the effects of quinine upon the spinal cord and peripheral nerves in man are as yet undetermined, its action upon the cerebrum is well known. This action is to cause hyperæmia, which, after the administration of small doses, is moderate in amount and productive of nothing save mental stimulation and even exhilaration. From the action of larger doses, however, there results a train of cerebral symptoms, probably dependent upon congestion, which indicate the over-effect of the drug; though the severer symptoms are uncommon, they nevertheless may occur and the condition even become one of fatal poisoning. What is to be considered the smallest fatal dose of quinine it is most difficult to say, for though death has followed the taking of 5 oz. in ten days, on the other hand single doses of 1 oz. have on several occasions caused scarcely more serious consequences than inconvenience. The milder of these symptoms are of frequent occurrence, and collectively are referred to as *cinchonism*, though the name is equally applicable, if less often applied, to the dangerous degrees of poisoning by cinchona and its alkaloids. Cinchonism of the degree commonly observed follows the administration of a full therapeutic dose of quinine (10 grains) or an equivalent, though individuality will exert a considerable influence upon the amount necessary to cause it. The first symptoms to appear are fulness in the head, tinnitus aurium, and giddiness; deafness, too, is a common occurrence and varies in intensity with the case. It may persist for a considerable time, but it is rarely permanent. If the dose has been larger these symptoms are intensified and there may be disturbances of vision, amblyopia or amaurosis. In the cases of severe poisoning by quinine, which are exceedingly rare, there occur severe headache, vertigo, dimness or disturbances of vision or blindness, deafness, delirium or stupor, dilated pupils, shallow breathing, weak and rapid pulse, convulsions, collapse, and death. The relief of milder grades of cinchonism is accomplished by withdrawing the drug or lessening the amount of its dose; but if persistence in large doses is required, the administration of a bromide or of diluted hydrobromic acid is thought by many to prevent the occurrence of the symptoms. For the severer grades of poisoning the stomach should be emptied if the case is seen sufficiently early; further than that the treatment is supporting and symptomatic.

A peculiar effect is sometimes seen as a result of giving quinine even in the smallest of doses—namely, the occurrence of various cutaneous eruptions, especially erythema, roseola, eczema, and purpura. These eruptive complications, however, bear no relation whatever to the physiological effects of the drug, and seem to be determined purely by the idiosyncrasy of the individual.

The therapeutic applications of the cinchona alkaloids are numerous. Locally, they are occasionally employed as mild antiparasitics, and internally they are much used as tonics, antiperiodics, antipyretics, and uterine stimulants.

Though, as has been said, the application of cinchona in powder to *unhealthy wounds* and *ulcerations* will often result in diminution of discharge and greater rapidity of healing, these effects of the drug are seldom sought, since other agents are more efficacious. As a mild antiparasitic for the cure of cutaneous diseases depending upon the action of vegetable parasites the local application of quinine is often of considerable value. *Tinea circinata* and *pityriasis versicolor* in particular are thus benefited. The application of a 5-per-cent. ointment of quinine sulphate will be found efficient. Insufflations of quinine have been employed in the treatment of *whooping-cough* by those who have thought the disease dependent upon the presence of a fungus in the upper respiratory passages, and for the same purpose considerable amounts have been given in solution to be slowly swallowed. For similar reasons a solution of the hydrochloride of quinine (from 4 to 8 grains to 1 oz.) has been painted upon the nasal mucous membrane, or applied by spraying, for the relief of *hay fever*, with asserted good results, and similar solutions

have been employed in the late stages of *gonorrhœa.*

In one disease the local employment of quinine is of very great importance. This is *amœbic dysentery*, in which, owing to its toxic action upon the amœba, rectal irrigation with a solution of quinine is of much value. The strength of the solution generally used is 1 to 1,000.

The internal administration of cinchona and its alkaloids as bitters is exceedingly common and their effectiveness is great. It must not be forgotten, however, that an astringent property is present in the bark itself which does not occur in its alkaloids; further than this, their applications are the same, *atonic dyspepsia*, *chronic gastric catarrh*, *debility*, and the weakness of *convalescence* being the particular conditions treated with them. It is maintained that for debility the alkaloids, and particularly quinine, are the more valuable since they are thought to diminish tissue waste more powerfully, and by some also to promote the formation of red blood cells. For the relief of these conditions quinine is very commonly given in combination with iron or with mineral acids. Like all the bitters, cinchona and its alkaloids are decidedly contra-indicated in acute gastro-intestinal inflammation, and their administration for too long a time, it must be remembered, is competent to cause gastric catarrh. (See Bitters.)

The most important therapeutic application of quinine is as an antiperiodic in the prevention and cure of *intermittent fever*. For those who are unavoidably exposed to the malarial infection quinine is an efficient prophylactic; though it may not invariably prevent the occurrence of malarial disease, it generally does, and, if it does not, it probably renders the subsequent malarial manifestations less severe than they otherwise would have been. For prophylactic purposes in cases of exposure to infection of average severity a daily dose of from 5 to 8 grains will be sufficient, and, though this may be given divided into a morning and an evening dose, there seems to be some advantage in the administration of the entire amount either just before or just after breakfast, in the morning, in a cup of black coffee, but administering it in a pill is little if any the less efficient.

Quinine is also extremely valuable in aborting the paroxysms of intermittent fever, and, as the maximum effect of the drug is obtained in about five hours after its administration, it should be given at least as long as that before the expected time of the chill. By some it is thought wiser in such cases to give the drug in divided doses, beginning about eight hours before the time the chill is expected, and then giving it hourly until two or three hours previous to the time for the paroxysm. There seems good reason to believe, however, that the single large dose is more effective for the purpose, and it should be given at the time already stated. What the size of this dose shall be will depend altogether upon the severity of the case. from 5 to 15 grains being appropriate for cases of ordinary intensity, while the severer cases require doses proportionately large. If time suffices, there is much to be gained by preceding the administration of the quinine by a free purgation, preferably with a mercurial, for the effect of this is undoubtedly to hasten the absorption of the quinine. If the time is very brief, however, and the importance of preventing the expected paroxysm is great, as, for instance, in pernicious cases, the quinine may be given hypodermically, and for this purpose the hydrochloride, the hydrobromide, or the bisulphate of quinine is employed on account of the insolubility of the alkaloid and its sulphate. Even these, however, are irritants when injected subcutaneously, and there are many who prefer always to give the drug by the mouth, for, even if there is not time for the prevention of the paroxysm, it is probable that a sufficient quantity may be absorbed to diminish its severity somewhat.

The cure of intermittent fever is accomplished by the daily administration, for ordinary cases, of from 15 to 20 grains of quinine in divided doses. For pernicious cases doses much larger are required, and from the outset the attempt must be made to cinchonize the patient and to maintain his quinine saturation until the symptoms have abated. In all cases the use of the remedy must be persisted in, not only between the paroxysms, but for a considerable time after their disappearance. Then the dose may be gradually diminished until, after several weeks have elapsed, it becomes no longer necessary. The importance of maintaining the free action of the bowels in connection with treatment by quinine has already been alluded to; not only is the treatment to be initiated by purgation, but during its course the intestinal activity must be maintained. It is not necessary that this should be accomplished by a mercurial, but there is, nevertheless, a marked advantage in using the mercurials for the purpose rather than other cathartic drugs, for not only is absorption more rapid after their administration, but the digestive disturbances resulting from malarial infection, which are especially likely to be of hepatic origin, are by the action of mercurials more thoroughly relieved. Another method of giving quinine for the cure of intermittent fever has been practised and is said to be most advantageous. Its efficiency is explained by the supposition that in the period that follows the paroxysm the organisms of malaria are most vulnerable to the action of quinine. According to this plan an ordinary case of intermittent fever is treated as follows: On the decline of temperature in the first paroxysm after the patient comes under treatment 20 grains of quinine are given, generally in one dose. By this the second paroxysm will generally be prevented, but if the temperature should rise slightly at the time when the second paroxysm is due 10 grains are given. After this, as a rule, no quinine is needed and none is given until the seventh day, when, to counteract the tendency of the disease to recur on the seventh day and its multiples, 20 grains are again administered. An interval

without treatment succeeds, and then another dose of 20 grains is given upon the fourteenth or the fifteenth day, and similarly upon the twenty-first or the twenty-second. In ordinary cases this, as a rule, suffices, though the occurrence of slight rises of temperature during the time of treatment is an indication for a full dose of quinine and the longer continuation of the treatment upon the plan described. As compared with the treatment by small daily doses of quinine this method certainly seems more reliable, for from the former relapse is common, even if the use of the drug is persisted in for many months, while from the latter it is apparently less frequent. Moreover, it is the more reasonable of the two, for large doses of quinine appear to cause the death of the plasmodium, while small doses seem competent only to prevent its activity and development.

In quinine we are possessed of the only reliable and sure antiperiodic, for, though other drugs are credited with being more or less efficient in the cure of intermittent fever, they are assuredly less potent and not to be relied upon. In its action upon intermittent fever quinine certainly seems entitled to be considered a specific, and its power appears to depend upon a direct poisonous effect which it exerts upon the cause of the disease, the *Plasmodium malariæ*. To this conclusion both reasoning and direct experiment point most strongly.

Though the effects of quinine in *remittent fever* are not so striking as they are in intermittent fever, they are nevertheless pronounced, and the remedy is to be given invariably. It is usually given in daily amounts of from 20 to 40 grains, in one or two doses, and, though there is no objection to giving it at the height of the temperature, and indeed by virtue of its antipyretic action it seems when so administered to cause a remission, yet the best time for giving it is that of a remission, for then the poison of the disease seems most vulnerable. With this end in view many have used antipyretic drugs other than quinine, also baths, to bring about the remission (Maclean preferring aconite), and then upon the fall of temperature have administered a large dose of quinine. Under this treatment the temperature generally becomes normal within a few days and the disease subsides, though for some time the use of quinine must be persisted in. In such patients the marked gastric disturbance generally present is an obstacle to the administration of quinine by mouth. This, however, may be practicable in some cases, though it is probable that in all of them absorption is less active than in the normal state, and this gives rise to loss of time and diminishes the effect. The drug may be given by enema, however, and the hypodermic administration, too, is allowable, especially for the first few doses, where rapidity and certainty of effect are all-important.

In *malarial cachexia* quinine is decidedly less curative than in the acute forms of malarial disease, probably on account of the visceral alterations present. Its use in such cases, however, will certainly be of some benefit and is to be recommended, especially in connection with the use of tonics, particularly arsenic. The irregular manifestations of malarial poisoning, especially *neuralgias*, are often difficult of diagnosis, and yet recognition of their cause is all-important, for the basis of their treatment is quinine, which is generally required in doses of considerable size. Neuralgias not of malarial origin, though rarely cured, are often benefited by the use of quinine. *Hæmaturia* is occasionally a manifestation of malarial poisoning, and for its relief large doses of quinine are required, a circumstance which in one way is singular, for quinine seems competent itself to cause hæmaturia at times. *Diarrhœa*, *dysentery*, and even *jaundice* seem sometimes to depend upon the malarial poison and to yield to the employment of quinine alone.

The antipyretic action of quinine has been much discussed and the value of its application in *febrile diseases* proclaimed and denied. There seems no doubt, however, that quinine is an antipyretic of considerable power if given in doses sufficiently large. How large these doses shall be will depend upon circumstances, but there is little use in giving for antipyretic effect a dose of less than 20 grains to an adult. After these doses the temperature usually falls within a few hours and remains lower for a time, varying from a few hours to a day. The routine employment of these large doses of quinine in fevers is, however, objectionable, for the lowering of a temperature not unduly high is therapeutic foolishness, especially when, as with the use of quinine, the digestive organs are apt to suffer decidedly from the practice. As an antipyretic, then, quinine should rather be used for the reduction of temperatures unusually high and manifestly and of themselves harmful. Thus employed, it is applicable for the hyperpyrexia of any febrile disease, but the antipyretic drugs more recently introduced, together with the employment of hydrotherapy, have rather usurped the position of quinine used for this purpose. Given in connection with the antipyretic bath, quinine in full doses often seems of considerable value in retarding the subsequent rise of temperature. In contrast with the large antipyretic doses of quinine are the small doses of the drug so often employed in febrile diseases. These, however, must be regarded simply as tonics and restoratives, and a high value placed upon them. Thus given, quinine is of great value in febrile diseases, especially if they are prolonged or accompanied by a tendency to asthenia. A patient with any febrile disease may thus receive benefit, but it has been thought that those with *typhoid fever*, *scarlatina*, or *erysipelas* are especially improved. In reducing the temperature of general *septic diseases* quinine exerts its usual antipyretic effect if given in doses sufficiently large, while in smaller doses it has its usual tonic and supporting action, but it has been employed in such cases, not for these effects alone, but under the impression that, as it is a local antiseptic, so after absorption it may have an antidotal action on the general

septic infection. Of such action there is not the slightest proof, and so far as any virtue of this kind is concerned the drug is apparently worthless.

The use of quinine in the earliest hours of acute inflammatory diseases is often apparently beneficial, and by some authors it is held to be competent to abort such inflammations. Of these, ordinary *coryza* is the most familiar example, and the practice of using a large dose of the drug to "break up a cold in the head" is common. It is to be doubted whether the practice is so efficient as is generally believed, and, though it may sometimes be effective, the "breaking up" is quite as likely to happen to the patient as to the disease. The giving of small doses at this time and for this purpose, in combination with belladonna and camphor, is more effective; the formula of a widely used pill for *rhinitis* is as follows:

℞ Camphor .... ¼ grain;
Fluid extract of belladonna . ⅛ grain;
Sulphate of quinine .... ¼ grain.

Mix and make into a tablet. One such tablet is to be given every half hour until the throat becomes dry, then one at intervals sufficiently short for the belladonna to maintain a slight dryness of the throat.

In the early hours of *amygdalitis*, *pneumonia*, *pleurisy*, *meningitis*, and similar inflammations the administration of quinine in large doses (20 to 40 grains) is by some regarded as potent to abort the disease, but meningitis would seem rather to contra-indicate than to indicate its employment, on account of the undoubted action of the drug in causing cerebral hyperæmia.

In various diseases of the respiratory tract quinine is undoubtedly effective. Its employment in *asthma* and *laryngismus stridulus* appears to diminish the spasmodic attacks, while the profuse expectoration often occurring in *chronic bronchitis* seems reduced by its use at the same time that the tonic effect upon the general condition is exerted. In *phthisis*, too, the drug is effective, serving to diminish the hectic symptoms and to maintain the patient's strength. In a similar way it acts as a tonic and sustaining agent in *prolonged suppurative processes* elsewhere in the body, and its application in surgical conditions of this nature is therefore common. In the slight degrees of *surgical fever* it is often employed with success, and *urethral fever* may be prevented or relieved by its use in considerable doses. The use of quinine as a uterine stimulant has already been referred to; though as an abortifacient it is of little or no effect, in the condition of *uterine inertia* often seen after labour has begun a full dose of it will serve to strengthen the pains.

In *rheumatism* quinine is sometimes effective in reducing hyperpyrexia, but a more valuable application, as in convalescence generally, is in the treatment of the debility and exhaustion which are so apt to follow rheumatism. For this purpose it is given in small tonic doses.

Besides these conditions, there are many for which quinine has been recommended and used—in fact, so many that it would probably be easier to mention those in which it has not been recommended than those in which it has.

The contra-indications to the use of quinine are few and have to some extent already been alluded to. Gastro-intestinal irritation and inflammation, if acute, are the chief of them. Though they are not necessarily prohibitory, in their presence the use of cinchona and its alkaloids must be cautious, and if it is not well borne the drug must be withheld. Acute inflammation of the genito-urinary tract is contra-indicative of quinine, for some degree of irritation of the urinary passages is a not uncommon effect of the cinchona preparations. An exception must be made in the case of hæmaturia of undoubted malarial origin, for which the employment of quinine is urgently demanded. Inflammation of the middle ear, too, is a contra-indication, on account of the increased vascularity of the aural region that results from the use of quinine.

Quinine may be given as such, but it is far more commonly employed as the sulphate. In the administration of the sulphate several methods are open to us. It may be given by the mouth in powder, in pill, or in solution. To its employment in powder there is the very strong objection of its having a very bitter and lasting taste. This taste, however, is never nauseating, and there are many who object but slightly to taking the drug in this way. If it is desired to give the drug in powder, the taste may be disguised by encapsulating it in a chocolate caramel and, to some degree, by its incorporation with ordinary chocolate. Quinine chocolates, indeed, are in the market (the salt contained is usually the tannate of quinine); and though they can scarcely be said to be free from a disagreeable taste, some mitigation of it is undoubtedly obtained, and for children in particular they are often serviceable. If quinine or its sulphate is given in pill, care must be observed that the pills are freshly made. This precaution is less necessary if the pills are uncoated, but even then the old and stony pill is most difficult of absorption. Doubly is the precaution necessary if coating is employed, for the coatings used are generally of sugar or of gelatin, and unless fresh are most defiant of solution. The same objection holds good in the case of capsules, which, however, if fresh, provide a very convenient form of administration. Compressed tablets are employed, but if they are broken up in the mouth they are offensive on account of their taste, and unless so broken up are liable to be passed from the bowels in a condition almost as intact as a sulphonal tablet which, in the writer's experience, made its gastro-intestinal journey and was then found to present the name of its maker stamped upon it as legibly as when it was made. The administration of quinine or its salts in wafer is an excellent method, and decidedly less open to objection than the others I have named, though there are some inconveniences connected with it not possessed by pills. If prompt absorption and rapidity of action are desired the remedy must be given in solution, and to accomplish this the bisulphate is employed; to

render an aqueous solution of not unreasonable bulk possible, there is added to the water to be employed dilute sulphuric acid or aromatic sulphuric acid in the proportion of one drop to each grain of the drug. If quinine itself is employed a solution may be effected by the use of any mineral acid.

If the administration by the mouth is undesirable or impossible, as not infrequently occurs in gastric inflammation, the rectum may be employed for giving quinine sulphate. For this purpose it is customary to wash out the rectum with warm water and then to inject slowly and carefully the required amount of quinine dissolved in a small amount of acidulated starch water, generally combined with laudanum for the purpose of diminishing local irritability. Expulsion is exceedingly likely to result in these cases, however, and, though the absorption is undoubtedly sufficient to render the method of practical value, yet the intolerance of the rectal mucosa is such that the practice can scarcely be long continued. Indeed, this is not to be wondered at when we remember that the reaction of the rectal secretion is alkaline and that quinine and its salts are precipitated by alkalies. Quinine suppositories have been used for the rectal administration of quinine, but they are of little value, being not even so well borne as enemata. The hypodermic administration of quinine is rarely necessary in the cases ordinarily seen in temperate climates, but in regions where the severer and the malignant forms of malarial disease are encountered its employment is often necessary, for it is in such cases that promptness of action of the drug is all-important if life is to be preserved. The hypodermic injection of quinine is, unfortunately, not free from danger; induration and abscess are common sequels, while gangrene and even tetanus are not unknown. Moreover, the injections are invariably painful. Why these things occur it is not difficult to understand when it is remembered that the reaction of the tissues is alkaline, that quinine and its salts are precipitated by alkalies, that quinine is an irritant to the tissues, and that for the perfect solution required of a preparation of quinine for hypodermic injection the addition of an acid is generally necessary. Many quinine salts have been suggested as sufficiently soluble for subcutaneous injection, and of these the hydrochloride, the hydrobromide, and the bisulphate are probably the best, though the sulphate may itself be given in an emergency and has the advantage of being more easily obtainable. Of these a 10-per-cent. aqueous solution of the hydrobromide is recommended by Gubler. Perfect solution is obtained by the employment of heat if necessary. The bisulphate of quinine is soluble in ten parts of water, and is therefore suitable for hypodermic injection, though the addition of a small proportion of sulphuric acid seems necessary to effect a perfect solution. The sulphate itself may be used, and Dock recommends a solution of 10 grains in the fluidrachm. This he prepares by mixing the salt with distilled water and adding dilute sulphuric acid drop by drop until perfect solution is obtained, when water is added to the required amount. Tartaric acid in excess has been strongly advised by some writers to preserve the quinine in solution when injected into the alkaline tissues, but Dock thinks the solution thus prepared far more irritating than others. The part selected for the hypodermic administration is preferably the back or loins, and the injection should be made deep into the tissues. The dose of the drug when so given is about half that suitable for administration by the mouth.

Though originally employed for the purposes now fulfilled by its alkaloids, cinchona manifestly suffers by comparison with them for application to the larger number of conditions I have named. At the present time, therefore, the preparations of cinchona bark are employed rather because of their bitter taste than because of their alkaloidal ingredients. As bitters, then, they are mainly useful, and they are frequently combined, in tonic mixtures, with the mineral acids and with iron. Of these preparations there are a number, those of the Br. Ph. and the Ger. Ph. being made from the red bark, while the U. S. Ph. allows the use of any bark which fulfils the 5-per-cent. requirement, save in the preparation of the compound tincture, where it, too, demands the use of the red bark.

The dose of *extractum cinchonæ* (U. S. Ph.), extract of cinchona, is from 5 to 15 grains. *Extractum cinchonæ fluidum* (U. S. Ph.), fluid extract of cinchona, and *extractum cinchonæ liquidum* (Br. Ph.), liquid extract of cinchona, are similar in strength to the solid extract. The dose is from 5 to 10 minims. *Infusum cinchonæ* (U. S. Ph.), infusion of cinchona, is prepared with the aid of 1 per cent. of aromatic sulphuric acid. It contains 1 part of cinchona in 16·6 parts. The dose is from 1 to 2 fl. oz. *Infusum cinchonæ acidum* (Br. Ph.), acid infusion of cinchona, is prepared in the same way. It contains 1 part of cinchona in 20 parts. The dose is the same. The dose of *tinctura cinchonæ* (U. S. Ph., Br. Ph.), *tinctura chinæ* (Ger. Ph.), tincture of cinchona, is from ½ to 2 fl. drachms. *Tinctura cinchonæ composita* (U. S. Ph., Br. Ph.), *tinctura chinæ composita* (Ger. Ph.), compound tincture of cinchona, Huxham's tincture, according to the U. S. Ph., is made from 10 parts of red cinchona, 8 of bitter-orange peel, 2 of serpentaria, and 7½ of glycerin in 100. The dose is from 1 to 4 fl. drachms. The British preparation is made from 2 oz. of red cinchona bark, 1 oz. of bitter-orange peel, ½ oz. of serpentaria rhizome, 55 grains of saffron, 28 grains of cochineal, and 1 pint of proof spirit. The dose is from ½ to 2 fl. drachms. The dose of *decoctum cinchonæ* (Br. Ph.), decoction of cinchona, is from 1 to 2 fl. oz. The dose of *mistura ferri aromatica* (Br. Ph.), aromatic mixture of iron, is from 1 to 2 fl. oz. The official alkaloids are four in number, but besides the alkaloids themselves several of their salts are official. *Quinina* (U. S. Ph.), quinine, appears as a white powder, amorphous or crystalline, without odour but having a very bitter taste. It is permanent in the air and soluble at 59° F. in

1,670 parts of water and in 6 parts of alcohol. The dose is from 1 to 20 grains, the smaller doses being applicable for tonic effect, the larger as antiperiodics. For the latter purpose a dose as large as 60 grains may be required in cases of great severity. Quinine itself is seldom employed in medicine, its salts, particularly the sulphate, being preferred.

Quininæ sulphas (U. S. Ph., Br. Ph.), *chininum sulfuricum* (Ger. Ph.), quinine sulphate, is more used than any of the other salts of the alkaloid. It appears as white, silky, needle-shaped crystals, without odour but of a very bitter taste. It absorbs moisture from damp air and becomes coloured on exposure to light. It is therefore to be kept in a dark place and in tightly stoppered bottles. It is soluble at 59° F. in 740 parts of water and in 65 parts of alcohol. It is soluble in 40 parts of glycerin as well, and may therefore be given in this menstruum to advantage. The dose is from 1 to 24 grains, though larger doses may occasionally be required.

Quininæ bisulphas (U. S. Ph.), quinine bisulphate, is similar to the sulphate in appearance, odour, and taste, but contains 13 per cent. less quinine. It is much more soluble than the sulphate, being dissolved at 59° F. by 10 parts of water. For this reason it is frequently administered by hypodermic injection. The dose for internal administration is from 1 to 24 grains.

Quininæ hydrobromas (U. S. Ph.), quinine hydrobromide, also strongly resembles the sulphate. It is soluble in 54 parts of water at 59° F. It is used occasionally for hypodermic administration, the solution being generally aided by the application of heat, for in boiling water it is very soluble. The dose, when given internally, is from 1 to 24 grains.

Quininæ hydrochloras (U. S. Ph., Br. Ph.), *chininum hydrochloricum* (Ger. Ph.), quinine hydrochloride, is similar in appearance to the salts already described as well as in its other characteristics. It is soluble in 34 parts of water at 59° F. The dose is from 1 to 24 grains.

Chininum tannicum (Ger. Ph.), quinine tannate, is of a far less disagreeable taste than the salts already mentioned, but is much less soluble and less prompt and energetic in action. The dose is rather larger than that of the sulphate; according to Wood, the amount is one third greater.

Quininæ valerianas (U. S. Ph.), quinine valerianate, appears as white, shining crystals having a slight odour of valerianic acid and a bitter taste. It is soluble in 100 parts of water at 59° F. It is generally employed in cases of neurasthenia and hysteria, and often seems most effective. The dose is from 1 to 2 grains.

The dose of *ferri et quininæ citras* (U. S. Ph., Br. Ph.), citrate of iron and quinine, is from 5 to 10 grains. The American preparation contains 12 per cent. of quinine, and the British 15 per cent. The *chininum ferro-citricum* of the Ger. Ph. is a similar preparation. The *ferri et quininæ citras solubilis* of the U. S Ph., soluble citrate of iron and quinine, is of the same composition as the simple citrate with the addition of a quantity of ammonia water sufficient to make the product more readily dissolved.

Quinidinæ sulphas (U. S. Ph.), quinidine sulphate, appears as white, silky needles, without odour but of a very bitter taste. It is soluble at 59° F. in 100 parts of water. Its actions and uses are the same as those of quinine and its sulphate, but feebler. The dose is therefore one third larger than that of quinine.

Cinchonina (U. S. Ph.), cinchonine, occurs as white, shining needles or prisms, without odour, and with little taste at first, but a very bitter after-taste. It is very insoluble in water. It is seldom employed in medicine, but may be given as quinine is. The dose is rather larger.

Cinchoninæ sulphas (U. S. Ph., Br. Ph.), cinchonine sulphate, resembles the quinine salts strongly. At 59° F. it is soluble in 66 parts of water. Its uses are those of the quinine salts, but it is less efficient. The dose is about one third greater than that of quinine sulphate.

Cinchonidinæ sulphas (U. S. Ph., Br. Ph.), cinchonidine sulphate, has characteristics similar to those of the salt last mentioned, and its uses and doses are the same. At 59° F. it is soluble in 70 parts of water.

Vinum quininæ (Br. Ph.), wine of quinine, contains 1 grain of quinine sulphate in a fl. oz. The dose is from ½ to 1 fl. oz.

Tinctura quininæ (Br. Ph.), tincture of quinine, contains 1 grain of quinine hydrochloride in a fl. drachm. The dose is from ½ to 2 fl. drachms.

Tinctura quininæ ammoniata (Br. Ph.), ammoniated tincture of quinine, contains 1 grain of quinine sulphate in a fl. drachm. The dose is from ½ to 2 fl. drachms.

Tinctura antiperiodica, antiperiodic tincture, Warburg's tincture, contains about 10 grains of quinine sulphate in 1 fl. oz. For the method of its administration see ANTIPERIODICS.

Besides the official preparations of quinine, a large number of its salts have from time to time been recommended as possessed of particular advantages. These advantages, however, are not strikingly evident. The *U. S. Dispensatory* mentions as examples of these salts the phosphate, citrate, acetate, lactate, camphorate, ferrocyanate, tannate, arsenite, antimonate, urate, hypophosphite, chlorate, hydrochloride with urea, citrothymate, sulphovinate, salicylate, sulphosalicylate, and meconate. (Cf. QUININE.)—HENRY A. GRIFFIN.

CINERARIA.—Several species of this genus of composite plants have had medicinal virtues ascribed to them. *Cineraria maritima*, or ragwort, was formerly used as a remedy for *amenorrhœa* and *hysteria*. Dr. Cerna speaks of it as being reputed to act beneficially in cases of *cataract*, 2 minims of the juice of the fresh leaves being dropped into the eye three times a day. The leaves of *Cineraria sibirica* are esteemed aphrodisiac in Switzerland.

CINNABAR.—Red mercury sulphide (see under MERCURY).

CINNAMON, the *cinnamomum* of the pharmacopœias, is the bark of several species of *Cinnamomum.* The U. S. Ph. recognises three varieties of cinnamon: cassia cinnamon, *cinnamomum cassia*, the bark of the shoots of one or more undetermined species of *cinnamomum* that grow in China, whence it is known as Chinese cinnamon, found in commerce in yellowish-brown rough quills, of varying length, which have a fragrant odour and a sweet, aromatic taste; Saigon cinnamon, *cinnamomum saigonicum*, which is the bark of an undetermined Chinese species, and is supplied in quills about six inches long; and Ceylon cinnamon, *cinnamomum zeylanicum*, which is the inner bark of the shoots of a tree of the same name belonging to the natural order *Laurineæ*, and occurs in long, closely rolled quills, composed of eight or more layers of yellowish-brown bark, of about the thickness of coarse paper, that has a smooth outer surface. The Br. Ph. and the Fr. Cod. recognise only Ceylon cinnamon, and the Ger. Ph. only the cassia cinnamon.

Cinnamon bark contains sugar, mannite, mucilage, and from $\frac{1}{2}$ to $1\frac{1}{2}$ per cent. of volatile oil. The latter contains from 75 to 90 per cent. of cinnamic aldehyde, C_9H_8O, and from 6 to 8 per cent. of eugenol, $C_{10}H_{12}O_2$, and cinnamyl acetate. The cinnamic aldehyde oxidizes to cinnamic acid, $C_9H_8O_2$. The oil obtained from the root, the bark, and the leaves differs; camphor is most prominent in the root oil, cinnamic aldehyde in the bark oil, and eugenol in the oil from the leaves. In cinnamon-root oil the cinnamic aldehyde is replaced by benzoic aldehyde, and safrol and terpenes are present.

Oil of cinnamon, *oleum cinnamomi*, of the U. S. Ph., is a volatile, yellowish, or brownish liquid, distilled from cassia cinnamon, and hence known also as oil of cassia; that of the Br. Ph. and the Fr. Cod. is the oil of Ceylon cinnamon. These oils resemble each other very closely in all their properties, except that the cassia oil has a browner colour, its specific gravity is greater, its odour is less delicate, and its taste is less sweet. It is sometimes adulterated with oil of cloves or with oil of cinnamon leaves. This may be detected by heating or by testing with ferric chloride. The dose of the oil is from 1 to 3 drops.

[Cinnamon water, the *aqua cinnamomi* of the pharmacopœias, is employed mainly to mask the flavour of disagreeable drugs. Tincture of cinnamon, *tinctura cinnamomi*, may be given in doses of from $\frac{1}{2}$ to 2 fl. drachms. The *spiritus cinnamomi* of the U. S. Ph. is a 10-per-cent. solution of oil of cinnamon in alcohol. The dose is from 10 to 30 drops.

The *pulvis cinnamomi compositus* of the Br. Ph. consists of equal parts of cinnamon, cardamom, and ginger. The dose is from 3 to 10 grains. The analogous *pulvis aromaticus* of the U. S. Ph. is a mixture of 35 parts each of Ceylon cinnamon and ginger and 15 each of cardamom and nutmeg; a fluid extract made from it by percolation and evaporation is known as *extractum aromaticum fluidum.*]

Cinnamon is an aromatic and stimulant. Chamberland (*Ann. de l'Inst. Past.*, i, p. 153) stated that no pathogenic micro-organism could resist the germicidal action of essence of cinnamon for more than a few hours. Lucas-Championnière (*Jour. de méd. et de chir. prat.*, 1893) and J. Chalmers Da Costa and D. Braden Kyle (*Therap. Gaz.*, 1894, p. 232) recommend the use of cinnamon oil as a dressing for wounds. The Ceylon oil causes very little irritation, and retinol added to ordinary cinnamon oil prevents that from irritating. It is a good antiseptic in *suppurative conditions* of the mucous membranes of the nose, larynx, and ear.

Landerer (*Therap. Monat.*, Feb., 1894) recommends a solution of 1 part of cinnamic acid in from 10 to 20 parts of glycerin as an injection in *tuberculosis of joint cavities*, into the fungous mass, or the joint, or into the gluteal muscles. He also recommends the injection of this acid or its salts in *pulmonary* and *intestinal tuberculosis.* Leucocytosis begins in from an hour and a half to two hours after the injection, which is preferably thrown into a vein, and reaches the maximum in eight hours; the leucocytes are increased, and there is no decrease in the red corpuscles or the hæmoglobin.

Internally, cinnamon is a carminative in *diarrhœa* and *colic* and a hæmostatic in *uterine* or *vesical hæmorrhage.* Some of its preparations are useful as stomachics in *indigestion* or *flatulence.* Surgeon S. T. Avetoom (*Brit. Med. Jour.*, 1895, vol. i, p. 530) recommends 1 drachm of finely powdered Ceylon cinnamon bark made into a ball with water, or taken in a powder wafer, morning and evening, as superior to ipecac in the treatment of *acute dysentery.* It causes, he says, neither nausea nor vomiting. He states that he obtained the idea from a Persian medical work.

[Mr. Charles Graham Grant (*Brit. Med. Jour.*, March 16, 1895) has employed oil of cinnamon, 2 drops three times a day, in *influenza*, with much apparent relief from the pain and prostration of the disease. Mr. H. A. Stonham has observed the same relief. Mr. James MacMunn (*Brit. Med. Jour.*, Apr. 6, 1895) reports the successful treatment of a case of *fœtor of the urine* by the internal administration of the oil.]—Samuel T. Armstrong.

CINNAMYL-EUGENOL.—See under Cloves.

CISSAMPELOS.—See Pareira.

CITRIC ACID, $C_6H_8O_7$, occurs in colourless crystals obtained from the fruit of several members of the genus *Citrus*, but more especially from the lemon, the lime, and the sour orange. It is freely soluble in water and in alcohol. It is more commonly used in the shape of lemon-juice or lime-juice, the crystallized acid being employed for the making of various pharmaceutical products and in the arts. Combined with the alkaline bases or with the majority of the metals, it forms salts which are, as a rule, freely soluble and easily absorbed. With the alkaline bases of carbonates it readily combines, with the evolution of carbonic acid, forming salts which are laxative, diuretic (increasing the amount of the water in the urine rather than its solid constituents), and diaphoretic. During the process

of absorption of these salts, the *citrates*, they are broken up and the carbonates of their bases formed, thus increasing the alkalinity of the urine and blood. For this purpose, however, they are not so efficient as the carbonates, except in cases in which the amount of acidity to be overcome is not great and those in which a laxative effect is an advantage. Externally, the acid is slightly irritant and caustic, but not sufficiently so to render it available for practical purposes. In all *gangrenous* and *aphthous affections* of the mouth and throat lemon-juice, freely diluted, forms an agreeable gargle or wash, and similar solutions may relieve *pruritus*, although there is no certainty of their acting thus. The juice from a cut lemon or lime, squeezed into the uterus, is often effectual in arresting *post-partum hæmorrhage*. Internally, large doses, either of the acid itself or of the juice of fruits containing it, act as irritants of the alimentary canal, causing colic, diarrhœa, and other disturbances of digestion. Like all acids, if given before eating, it decreases the acid secretions of the stomach, but is inferior for this purpose to the mineral acids. Free uric acid in the urine increases under its use, and uric-acid calculi may be formed, a point to be noted when it is to be used as a diuretic or drink in conditions in which there is an excess of that body present. In such cases the addition of a few grains of potassium carbonate will counteract that tendency. At one time it was highly recommended in the treatment of *acute rheumatism*, but experience has shown its inferiority to many other remedies for that purpose. *Menorrhagia* is sometimes restrained by sucking a lemon or lime, and for all other forms of hæmorrhage it may be used if nothing else is attainable. Mild cases of *jaundice*, especially of that type which often prevails as an epidemic in warm climates, need little treatment beyond the free use of lemonade or limeade. In all cases in which there is to be a continued use of these last-named beverages as little sugar as possible is to be added, as it is apt to disorder the digestion, and whenever the free acid or lemon-juice or lime-juice is employed the mouth must be rinsed out after its use with a weak alkaline solution, to prevent its attacking the teeth. In malarial regions a teaspoonful of lemon-juice with a little common salt or an equal quantity of strong coffee is regarded as being useful in preventing the occurrence of *intermittent fever*. *Scurvy*, which in the past was of almost universal occurrence on long sea voyages, has been entirely done away with by the use of gill doses of lime-juice every day, lemon-juice being slightly less effective. The scorbutic condition which is sometimes seen in infants is also relieved by the free use of lemonade, the exciting causes in the shape of improper or insufficient food being corrected. The use of these juices has been suggested to sterilize suspected drinking water in epidemics of *Asiatic cholera*, but, while more or less efficient, they are probably not so efficacious as sulphuric acid. A teaspoonful of lemon-juice added to castor oil or cod-liver oil is in some cases an effectual means of disguising their unpleasant odour and taste. Quinine and other bitter drugs may be given in lemonade made to effervesce by the addition of a few grains of an alkaline carbonate. Equal parts of lemon-juice and glycerin are often used to relieve the irritation caused by *sunburn*. [A teaspoonful of a 5- or 10-per-cent. solution of citric acid, added to a glass of water, has been recommended as a gargle in *diphtheria*, on the germ of which disease the acid is said to exert a very destructive action. Slices of lemon taken into the mouth have been used in the case of children.]

The citrate of any alkaline base may be prepared extemporaneously by the addition of the carbonate to lemonade or limeade, and is most easily and pleasantly taken during the effervescence which occurs. Used in this manner, the carbonates of potassium must be finely powdered, as they dissolve slowly when in their crystalline form. (Cf. EFFERVESCING PREPARATIONS.) Lemon-juice has been used to prevent or reduce *corpluence*, but when it does so it is at the expense of the digestion. A few drops squeezed on either raw or cooked meats render them more palatable and more easily digested by invalids or those with a feeble appetite.

A solution of 40 grains of the acid in 1 oz. of water is of about the same strength as lemon-juice, but becomes mouldy and soon decomposes. The *syrupus acidi citrici* (U. S. Ph.) is used as a vehicle to form effervescing solutions with the various alkaline carbonates and, mixed with water, as a beverage.

RUSSELL H. NEVINS.

CITRINE OINTMENT. — See under MERCURY.

CITRULLUS COLOCYNTHIS. — See COLOCYNTH.

CLAVETHYL.—A solution of 1 part of salicylic acid and 3 parts of Venice turpentine in 50 parts of collodion, used as an application for softening *corns*.

CLIMATIC TREATMENT.—The subject of climate is so broad, being now made to include so large a variety of atmospheric conditions, made variously applicable to a wide range of diseases and localities, that one needs to carefully limit his field if he is not, as in the present case, permitted to go over the whole ground. This I do the more willingly because I believe there is a too prevalent tendency to vaguely scatter, to go back to individual sensations as proof, or to unreasonably "boom," so to speak, given localities. At the recent Congress of Medico-Climatology Auxiliary of the World's Fair reports were presented from widely separated districts—high, low, inland, and seaboard, both within and without the boundaries of the United States—which were so fulsome in praise of each special locality reported on that the listener, without a settled basis of judgment as to preferable climatic attributes, naturally comes to the conclusion that nothing is left to be desired. This is absurd, and leads to confusion. It is also questionable if going into the minutiæ of weather statistics (such as the daily range of temperature, the hottest and coldest day in a given month or year, etc.) of

given localities is the proper thing to do. Time is consumed and the mind becomes bewildered in a maze of unessential particulars which are apt to lead away from the consensus of knowledge needed. But there may be a few who wish to have each particular point studied out for them on such a detailed basis, and for such Dr. Huntington Richards, in the *Reference Handbook of the Medical Sciences*, has well performed the laborious task. An excellent historical and geographical study of the climates of that part of the world inhabited by English-speaking people may be found in a late work* by Dr. Williams, of London, than whom there is no more celebrated writer on the therapeutics of climate in lung diseases. For the comparisons of the various climates of the United States, so far as they may be made from the most valuable of all weather statistics—*the annual and seasonal averages*—the reader is referred to the author's *Climates of the United States in Colours*.† The graphic display of so many signal-service observations—some eight million—representing all the weather stations in the United States, is deemed a most effective way to impress the mind with the climatic contrasts afforded within our own boundaries, and the accompanying tables are the authority for many of the conclusions reached in this article.

As to the scope and purpose of this present study, the treatment of kidney and kindred complaints by thermal baths and mineral waters must, for obvious reasons, be delegated to the one who writes on Mineral Waters. Dr. C. W. Purdy‡ has made a study of the relations of climate to *Bright's disease* in the United States. Taking the census of 1880 as a basis, he finds that the recorded deaths from Bright's disease are greatest in the Middle and New England States and the smallest in the South Atlantic and Gulf States. He summarizes the results obtained from a careful statistical study as follows:

1. That the chief features of the climate in the United States which most strongly tend to increase the death-rate from Bright's disease are cold, moisture, and changeability of temperature.
2. That the elements of climate which tend in the greatest degree to decrease the death-rate from Bright's disease are warmth, dryness, and equability.
3. That cold most decidedly increases the mortality from Bright's disease when associated with moisture, a comparatively low temperature being well borne if the atmosphere is a dry one.
4. That a comparatively high degree of humidity of the atmosphere does not strikingly increase the mortality from Bright's disease if accompanied by warmth and equability.
5. That the most unfavourable residence localities for patients affected with Bright's disease in the United States are comprised within the Atlantic Coast region and the north-eastern hills, which include the States of New Jersey, New York, Connecticut, Massachusetts, New Hampshire, and Vermont.
6. That the most favourable residence localities are chiefly comprised within the Southern interior, and especially include the States of Tennessee, Georgia, North Carolina, Arkansas, and Texas.

Other special diseases, also the influence of climate upon the nervous system, upon age, sex, and occupation, etc., must necessarily, for lack of space, only be considered here incidentally or by association, and I shall devote myself more particularly to that class of diseases with which climate has both the greatest causative as well as curative effect—namely, *chronic pulmonary diseases*. However interesting the history and ætiology of such diseases are, we must still further abridge our present work to a study of the *rationale* of the most favourable effect of climate upon lung diseases, taking *pulmonary consumption* as both the most important in a statistical sense and the most decidedly influenced in a climatic way. This study of the air with regard to the production and cure of the human air organ's diseases ushers us immediately into a controversy which has more than any other occupied the attention of climatologists for the past thirty years. It is the question of air pressure and the susceptibility—or adaptability—of the human organism to it under varying states of health and disease. Without seeming to controvert the great general argument—that of "*purity of atmosphere*," always used by those who do not admit the importance of this air-pressure question (for that argument is a side issue and needs no controversion)—the question of *altitude* or sea-level pressure can not be ignored in the climatic prescription we are required to inscribe. In many parts of our country the medical mind is so much at variance as to questions of fact and experience that conviction through a logical presentation of both fact and experience seems to be what is most of all needed. Let this be a sufficient excuse for any argumentative tone in the following presentation, and let us ignore any given locality and consider the chief attributes—those variously considered as most effective in the production of what is called climate.

These are: 1. *Elevation* above the sea (rarefaction). 2. *Dryness* of the air, both absolute and relative. 3. *Temperature* of the air, whether cold, cool, or warm. 4. *Sunshine*—its preponderance or average daily duration at a given place—which introduces the important questions of *cloudiness* and the *diathermancy of the air*. 5. *The winds*, which introduces many correlated causes, such as the seasonal changes, the configuration of the earth's surface at a given place, the ocean tide, storm winds daily, or periodical currents of mountain or sea air, etc. 6. The *character of the soil*—of great importance

* *On The Treatment of Lung Disease by Climate*, being the Lumleian Lectures for 1893. By Charles Theodore Williams, M. D., etc. Macmillan & Co., London and New York. The author's *Rocky Mountain Health Resorts* (Houghton, Mifflin & Co., Boston) is also referred to for a description of the interior health stations of our own country.

† The W. T. Keener Co., 95 Washington Street, Chicago, or The Denver Surgical Instrument Co., 1405 Stout Street, Denver, Col.

‡ Sajous's *Annual of the Universal Medical Sciences*, 1891.

with reference to the proportion of forests to dry land, the contiguity to the sea or large bodies of water, and the general configuration of the earth's surface. 7. The *variability* or *equability of the air temperature*, which have heretofore been made too much of, as they are largely, like some other attributes, relative—the former to *altitude* and the latter to the *sea*. 8. *The electric condition of the atmosphere*, which is also decidedly relative to mountain and sea air currents, but which is none the less important as affording desirable *stimulation*.

In choosing from such attributes the most desirable combination for the arrest of lung disease, the writer feels called upon to explain why he does not place *altitude*, the most important of all, at the head of the list. It is—

(1) Because altitude shows its effect upon each important attribute, and thus in a fair analysis gets a reasonable allowance of praise; and

(2) Because the place of altitude is needed for the special consideration of air rarefaction as a potent force in respiratory diseases hardly second by itself to any other attribute, yet at least entitled, in the minds of the majority of physicians, to hold the third place in the following classification. In formulating this list of preferable attributes of climate the writer will take the liberty of drawing largely upon his own argument,* formulated for the Ninth International Medical Congress (1887) and based upon principles and conclusions presented to the previous International Medical Congress (1876), which have been both generously and favourably received by the medical profession.

I. *Why Dryness is Preferable to Moisture and is placed First.*—We should have a line of demarkation between these two opposing qualities of the atmosphere—a subdivision that would be fair and acceptable to all, so that there could be no confusion in the use of the terms *dryness* and *moisture*. It seems to the writer that the average of the combined hygrometric conditions of the atmosphere for the whole inhabited portion of the country is a fair division line between these two opposite conditions, and we will accept this as the line of definition. Of course, temperature must be accounted for, as the capacity of the air to hold moisture varies so greatly, according to this record the variation being from about ½ a grain to the cubic foot at zero to nearly 20 grains at 100° F. when the air is saturated. This was the foundation of the writer's "rule for determination of moisture and dryness." † This rule was based upon the calculation of a table representing the average of the combined humidities of the air (cloudiness, absolute and relative humidity) for the whole United States and for every degree of temperature. The averages of these three evidences of humidity were found to be 44·5 per cent. representing the time the sky was clouded, 67 per cent. for relative humidity, and consequently 67 per cent. of saturation for absolute humidity. These means were accepted by the late chief Signal Service officer, General Hazen, to be as nearly correct as could be determined. A rating table of means of these three attributes having been constructed for every degree of temperature (see table on map for spring in *Climates of the United States*, previously referred to), the following rule was formulated:

"First find for the given time and place the per cent. of relative humidity and cloudiness and the absolute humidity in tenths of a grain of vapour to the cubic foot of air. Then compute the difference between one third of these three and the standard number (the mean) given opposite the proper temperature in the rating table, and the result, plus or minus, will show the relation of the given climate to the average for the United States. An excess of six locates a place in *moderate moisture*, and over six in *extreme moisture*, while a deficiency of six belongs to *moderate dryness*, and of more than six to *extreme dryness*." The graphic illustration of this rule on coloured maps compared with mortality statistics shows that the arrest of phthisis is far more surely to be accomplished as you go toward the extreme of dryness from the mean than as you go in the opposite direction from the mean toward the extreme of moisture. Indeed, it is the very moist climates which furnish most of the cases to be arrested in the very dry sections.

In the writer's opinion, the chief argument in favour of atmospheric dryness is based upon the increased transpiration of aqueous vapour from the lungs in a degree according to the dryness of the air breathed. The germs of disease need warmth and moisture in which to live and flourish—a climate tempered and constituted according to the requirements of their peculiar existence. It is reasonable to infer that the preference shown by tubercle bacilli for a *locus habitandi* in pulmonary tissue is in no small degree governed by the catarrhal or other products of inflammatory change which clog or close the alveoli and connecting bronchioles. Well, then, if these secretions or morbid products could be removed and at the same time the bacilli which inhabit them thrown off, the result would certainly be salutary. These could be so expelled if they could be reached by the inhaled air, and this in turn had the requisite absorbent power. This absorbent power is just what the inhaled air possesses through its quality of dryness and in proportion thereto. Absorption takes place through the difference in percentage of saturation (relative humidity) between the inspired and expired air, and also much more through the difference in quantity (absolute humidity) between the moisture inhaled and that expelled. This especially takes place if cold air is inhaled, which is then raised to the temperature of the body and has greater power for holding moisture. Valentine, Sanctorius, Lavoisier, Seguin, Dalton, and others have investigated the subject of transpiration, but not to differentiate between persons at different altitudes and temperatures. In his analysis of humidity statistics (*Moisture and Dryness*) the writer made an attempt to compute this difference in

* *The Preferable Climate for Consumption.*

† *Moisture and Dryness.* Report made to the American Climatological Association, 1884. Rand, McNally & Co., Chicago.

transpiration. He took Draper's statement as the basis of his calculations—namely, that the dew point of the expired breath is 94° F. However, candour compels expression of the suspicion, chiefly based upon the increased thirst and augmented respiratory activity in those who live in elevated and very dry sections, that the dew point given may be too high for such dry regions. This is less than Dalton's estimate, who says the expired air is in a state of saturation. So it was concluded that the expired breath was 94° F. Three kinds of estimates were made by way of comparison :

1. Difference in vapour transpiration between a warm moist (Jacksonville, Fla.) and a warm dry climate (Yuma, Ariz.) of about the same elevation. These two signal stations were chosen, and for the autumn of 1883, because their temperatures were the same—*i. e.*, 71·3°. An ordinary-sized man was assumed to breathe eighteen times in a minute (Quintelet) and to expire when at rest 20 cubic inches at each breath (Hutchison, Flint, Jr., and others), and that the loss of breathing—*i. e.*, the used-up atmosphere—from $\frac{1}{70}$ to $\frac{1}{50}$ in volume (Davy and Currier) is made up by the expansion of the air in the lungs through its being raised from 71·3° to the heat of the body. The following was the result: The mean temperature being the same, the vapour in saturated air to the cubic foot (Glaisher) was 8·33 grains. The mean relative humidity for Yuma was 428 grains, and 774 for Jacksonville. The cubic feet of air breathed in twenty-four hours were the same, 300. Then the grains of vapour inhaled were in Yuma 1,070 to 1,934 in Jacksonville, and the grains of vapour exhaled with the dew point at 94° were 5,007 for each place. This gave vapour exhaled more than inhaled for Yuma 3,937, and 3,073 for Jacksonville, or an excess for Yuma over Jacksonville of 864 grains a day. This is the moisture thrown off from the lungs in a given dry climate in excess of that in the rather moist one of the same temperature and no exercise taken. When one makes allowance for the increased respiratory activity due to exercise, he is enabled to realize the still greater difference in transpiration as shown by Dr. Edward Smith's calculation, that "one at sea level, walking at the rate of three miles an hour, consumes three times as much air as when at rest." The ordinary every-day exercise of a man would make this difference in transpiration under the given conditions equal to about a gill in twenty-four hours.

2. When we make this calculation for places of different temperatures and elevation the evidence becomes still more conclusive, for cold is probably the most important factor in the production of dryness, and elevation is not far inferior, because it, in turn, produces cold as well as expansion in the volume of the air. It is just to allow for elevation an equivalent to the proportionate rarefaction of the air—*i. e.*, if the pressure is one fifth less (twelve pounds to the square inch) at Denver than at Jacksonville, then one fifth more air will be breathed at the former station. In this calculation we will assume a good-sized man, thirty years old, as breathing in both Denver and Jacksonville twenty breaths a minute and thirty cubic inches a breath (Dr. Grehaut), ordinary exercise included, and for the same season as that used before. This gives, by the same method of reckoning, vapour exhaled above that inhaled in twenty-four hours, 8,900 grains for Denver and 4,939 for Jacksonville. This is the excess of transpiration of moisture in favour of Denver of 3,961 grains, or over eight ounces, or two gills, in twenty-four hours. Two important considerations would further add to this difference in evaporation of moisture from the lungs in favour of the high-altitude station :

a. The expansion of the air in being raised in the respiratory tract from the lower temperature of the atmosphere to the higher temperature of the body.

b. The increased amount of exercise naturally indulged in at the higher station, due to the stimulation of the cold, electrical influence, etc., and the augmented effect of exercise upon the respiratory functions.

3. For the purpose of still further comparison, it is instructive to take a cold, dry place in winter (year 1883, Cheyenne, Wyoming) and a *warm*, moist one in summer (Charleston, South Carolina) on the same basis (though Cheyenne is a little more elevated than Denver). The calculation is carried out on the same plan as before, and results in vapour exhaled above that inhaled in twenty-four hours, 9,881 grains in Cheyenne and 3,615 in Charleston; excess of respiratory evaporation in favour of Cheyenne in winter over Charleston in summer, 6,266 grains or 13 ounces. If the two modifying effects previously mentioned were to be taken into consideration, together with the usually increased activity of the respiratory organs in such cold as compared with such warm weather, the result would show for Cheyenne in winter a daily passing off of vapour from the lungs of at least a pint more than for Charleston in summer. This result accords with the sensations and the greatly increased thirst experienced in cold dry climates, especially when exercising. This proof of the increased pulmonary evaporation due to the coldness and dryness of the air can not be ignored, though the stated records of pulmonary transpiration may be modified by different allowances for elevations and the dew point of the expired air. It appears as we proceed in this analysis that every successful climatic constituent favours or produces this one which we have placed at the head of the list.

II. *Why Coolness or Cold is Preferable to Warmth or Heat.*—The importance of *cold* in the composition of the curative atmosphere we seek is hardly less than that of *dryness*. In fact, the two are so interdependent and necessarily associated that they can not be easily separated. If the thermal units coming from the combustion of effete material which should be thrown off through the lungs may be considered as indices of the natural cleansing of the system, then the tremendously augmented expenditure of heat units required in cold climates to maintain an equilibrium of bodily temperature must be credited for this

great purifying influence. This potent effect is still further augmented by the greater transpiration of vapour from the lungs in dry, cold climates, above proved to take place, because such transpiration is represented by the latent heat of vapourization, also necessarily thrown off. This temperature problem naturally introduces the following considerations:

1. How much atmospheric humidity is influenced by the element of temperature is shown by the sensory effect of cold. It is through conduction, chiefly, that the body parts with its heat. Evaporation and radiation together do not equal this power of conduction which the atmosphere, in common with everything that touches the body, possesses in no small degree. Now, the conductivity of the air depends greatly upon its moisture. It is with the air as it is with solid substances. A bar of iron feels very much colder than the same-shaped piece of dry pine, though they both may be of the same temperature. The iron is by far the better conductor, just as moist cold is compared with dry cold air. To those who have never previously experienced a dry, cold, and sunny morning on the eastern slope of the Rocky Mountains there is a deception in the sensation of cold which is equivalent to from fifteen to twenty degrees. One seems to be in a much warmer atmosphere than that in which he really is. Temperature, then, is a relative attribute, and can not be considered as independent of humidity. Besides the drying effect of cold upon the atmosphere already alluded to, low temperature has several remarkable as well as useful effects in the arrest of phthisis.

2. Heat expands the air, so that the contrast between the temperature of the atmosphere and that of the body indicates the swelling effect cold air produces when full breaths are taken. Any doubt about this can be dispelled by trying the simple experiment of breathing one's utmost into a spirometer in a heated room when the air is frozen outdoors. Then step to the door, take a full breath, and try again; the difference should in part indicate the expanded force heat imparts to the inhaled air. This lung-stretching capacity of inhaled cold air is especially appreciated by those of us who hold that it is most often *the lack of use* which paves the way to infiltrations or tubercular deposits in the apices or other portions of the lung periphery. It is to these out-of-the-way places that the expanding air carries the evaporating influence of dryness.

3. Cold stimulates and heat depresses. This is a generally accepted proposition which needs no extended elaboration. The sensations themselves are a good guide, and the colder the air the more stimulating it is. As Dr. Wise expresses it, when speaking of the winter climate of the snow-covered region of the Alps, "a bright sun and blue sky overhead, a clear and quiet atmosphere, distant sounds transmitted to the ear through the still air, combine with the charms of the scenery to produce such a buoyancy of spirits that a man is braced and invigorated for almost any exertion." It is in harmony with this stimulating effect of cold that the respiratory function should be diminished in activity in hot climates, and an increased amount of blood be found in the lungs of those who live in cold countries, as is shown by Parkes, Rattray, and Dr. Francis, of the Bengal army. The last of these found, from a large number of observations, that the lungs were lighter in Europeans in India than the European standard. The increased quantity of blood circulating through the lungs of course means increased oxidation of the blood and renewal of tissue. The pulmonary lymphatics join in the increased activity, the nervous system is exhilarated, and the whole nutrition is improved.

4. Cold not only is stimulating and encourages needed exercise, but under certain conditions may result in a desirable sedative effect. The sleep which comes at night after a day's exhilaration and excitement induced by cold is the most refreshing of all rest. Dr. Wise refers to the analogous somniferous effect of cold upon animals which hibernate. Dr. George Bodington, one of the first to appreciate the dry cold-air treatment of consumption, wrote in 1840: "The application of cold pure air to the interior surface of the lungs is the most sedative, and does more to promote the healing and closing of cavities and ulcers of the lungs than any other means that can be applied."

5. The effect of cold in destroying or impeding germ life, especially the life of the bacillus of tuberculosis, is a most important consideration. This is diametrically opposed to the fostering of nearly all germ life which is the effect of moisture and mild heat. If one has ever "camped out" on the top of a Rocky Mountain pass, as the writer did on a given occasion, he will never forget the noiselessness of that insectless and germless locality. The only sound heard was that of a solitary cricket; and as for bugs and flies, it would have been a paradise for some tormented housewife whose life is made a burden by these evidences of atmospheric vitality. The nightly freezing of the air, together with its dilution through lessened air pressure, is enough to render germ life impossible. But the best evidence is that which has reference to the climate and natural life conditions of the bacillus, limited as they are to a narrow range of temperature. This most interesting information is given us by Dr. Weber in his excellent Croonian Lectures on *Chronic Pulmonary Phthisis:* "The air we inhale does not perhaps so often contain the fully developed bacillus as is supposed by many people, for this microbe does not thrive in the air at the usual temperature, but requires, according to Koch, a temperature approaching that of the human body. Its growth entirely ceases below about 82° and above 107° F., and it thrives best at about 98° to 100°, while other pathogenic microbes have a much wider field —for instance, the anthrax bacillus, which grows luxuriantly between 67° and 74° and up to 110°." It may be maintained that the air being warmed immediately on entering the upper air-passages prevents the operation of cold where the bacilli are. Yet it will have to be admitted that the temperature of the air

within the bronchi must always be related to that outside the body, and also that the expanding effect of heat, greatly increasing the absorbing power of the already dry air, must bring an increased number of the bacilli within the range of the remedial cold air.

6. The investigation of seasonal effects in phthisis shows the salutary influence of cold. This may appear strange to those people of the North Atlantic, Middle, and Lake States who flee to the South in terror of the winter weather. Admitted. But do not thousands yearly leave moist England for a winter stay in the frozen uplands of Switzerland? The force of this consideration is not appreciated except through a recognition of the importance of dryness. Notice on the winter seasonal map (previously referred to) the prevailing northwest, west, and southwest winds, some one of them everywhere moving toward the great interior lake region of the United States. The cooling of the air currents causing condensation of vapour, with the addition of moisture already existing, is enough to produce cloudiness in this section for from six to eight tenths of the winter season. The effect of cold moisture (already referred to) renders this a climate to be avoided by enfeebled lungs. When, however, the other attributes—dryness, elevation, and sunshine—are favourable, the winter is the best time of the year for most consumptives. In cases suitable for positive treatment these favourable climatic conditions, by means of this cooler temperature, can be increased to a climax, so to speak, of success not otherwise obtainable. The experience of invalids in Colorado bears out this conclusion. It is to secure the cooler temperature in summer time that some of the phthisical patients from the plains are sent higher up to the parks and divides of the Rocky Mountains. The effect of the change is very generally good; and a tubercular fire which had rekindled in Denver on the advent of warm weather was rearrested, as appearances indicated, by a sojourn in a cool park 8,000 feet above the sea. Medical men residing along the eastern base of the Rocky Mountains have very generally come to the conclusion that certain classes of pulmonary invalids do better in winter than in summer, especially those patients who were always getting worse in hot weather, and many of them perhaps subject to malaria.

III. *Why Rarefaction is better than Sea-level Pressure.*—The consideration of elevation is divided into—

(1) The effect upon other climatic attributes. Then aside from this there is the mechanical effect of rarefaction.

(2) The physical influence upon man in health.

(3) Then its effects in disease and the experience of invalids, also chiefly mechanical; and

(4) The evidence of immunity from phthisis.

1. I have already adverted to the influence of rarefaction in producing dryness and coolness. Its effects upon sunshine, diathermancy, variability of temperature, wind movements, radiation, quick drainage, etc., will appear as we proceed. The expansion of the air is equivalent in degree to any given elevation. The additional space occupied carries with it its due proportion of atmospheric moisture. In localities favourable for health resorts this deprivation usually more than counterbalances the condensation of vapour which is due to cold. The result is a total decrease of moisture, which is shown by a small percentage of cloudiness, a low relative humidity, and also a small absolute humidity for all such favourable localities (see seasonal charts already referred to). Then through its expansive effect on the air, as well as by its influence upon other producers of dryness, elevation is a powerful agent in controlling atmospheric humidity.

As to temperature, elevation has a constant effect in the production of cold. It is differently estimated by those who make accurate calculations, but does not vary greatly from about three degrees for each 1,000 feet of rise. In some favourable localities, such as the eastern slope or base of the Rocky Mountains, this lowering temperature is neutralized by local conditions, such as the excess of sunshine, the character of the soil—being dry and sandy—and the protection of mountain ranges which drain western humid air currents of their moisture, so that the isotherms, as a given elevation is reached, continue on a western course only till the high mountains turn them southward.

2. As to the physical effect of rarefaction upon human beings, the evidence is not insignificant or to be lightly called in question by those who have had no experience with high-altitude resorts. Dr. Jourdanet * gave us a most complete and elaborate exposition of the physiological effects of diminished air-pressure, and not content with this analytical investigation, he induced Paul Bert † to work out by experimentation, chiefly on the life of birds, the effects of equivalents of various elevations, even up to starvation limits, as to the supply of oxygen. These and many other investigations might be elaborated if space permitted. Ignoring their trivial differences, I will state only settled conclusions. Lessened atmospheric pressure leads to an equivalent loss of oxygen, which deficiency Parkes, in his *Practical Hygiene*, says is not felt by animals till a rarefaction equal to 14 per cent. is reached. This loss is about equal to an elevation of 10,000 feet, and many animals—cats, for instance—do begin to live an abbreviated existence at this height. But there are previous effects which man can appreciate all the way from 3,000 to 6,000 feet, at which latter limit the air is one fifth rarefied, and this appreciation is from nothing to considerable, in a state of rest, according to the sensitiveness of both the heart and lungs, or one of them. There is an adaptability of these organs in perfect health which more than compensates for a rarefaction of one fifth, so that only a pleasant exhilaration is felt, even with moderate exercise. Much exertion strains this adaptability, and a degree of breathlessness may be reached which indi-

* *Le Mexique et l'Amérique tropicale.*

† *La pressure barométrique, recherches de physiologie expérimentale.* Paul Bert, Paris, 1878.

cates a decided deficiency of oxygen compared with the immediate requirements. However, it is not the point of injury or danger that is intended to be recommended, but the altitudes which produce healthful and well-borne respiratory activity in states of rest and moderate exercise. The effect of altitude varies according to the pulmonary or cardiac susceptibility of the individual. We divide these manifestations into (1) first effects and (2) permanent effects or acclimatization.

On the arrival of a healthy individual in a high altitude, there is first an increase, both in frequency and in depth of respiration. When adjustment to the new conditions has taken place, which requires a variable period, according to the altitude and the individual, the respirations are not nearly so much increased in frequency during rest, but the depth of breathing is habitually greater. This is shown by the large spirometrical records of those who live at great elevations, and the increased size of the chest in children and in resident adults. This is further shown by the necessity of the climatic change to supply the usual, if not augmented, demand for oxygen, which is to meet an increased combustion or change of tissues. The increased exhalation of carbonic acid due to the chest expansion and lower air temperature, as well as the increased chest measurements in those invalids who are not so far advanced in disease but that the affected lung tissue can be returned to use (an effect noted in the writer's cases, as well as those of C. T. Williams, Weber, and others), is in perfect accord with the habitual use of more air for all the purposes of living in high altitudes. The heart and lungs, having a reciprocal relation to each other, are both proportionately more active. In imperfect respiratory states, such as incipient phthisis, the impeded circulation feels the "boom," so to speak, especially in those portions of the body which were the least active before—namely, in the lung periphery and the capillary system generally. The result is a more perfect circulation of the blood and oxygenation of healthy tissues, as well as of carbonaceous and effete materials. The supply and waste are more completely attended to, and the sewer work of the respiratory system especially is a cleaner and more finished process. Not only this much, but there is a change in the relative density of the air in the lungs, due to this increased activity and to the fact that the air breathed is rarefied. There is a "pneumatic differentiation," as the inventors call it, going on all the time, and this is better than any spasmodic or artificial effect. There exists an alternate greater pressure or density with expiration, and diminished pressure or rarefaction during inspiration, with each respiratory act—*i. e.*, compared with the air-pressure outside the body, and also compared with the usual change of density of the air in the lungs during respiration. This increased outward pressure within the lungs is especially salutary in chronic hypertrophies, etc., of bronchial and alveolar lining membranes, and it has a tendency to open up passages closed to the entrance of pure, dry air. Some of the worst cases of phthisis are those where the air can not reach the microbes or morbid products.

3. It is this question of increased and lessened air-pressure, the augmented respiratory activity and the rush of blood into and through the pulmonary capillaries, which seems to disturb the judgment of many physicians with reference to the liability to the occurrence of pneumonia or pulmonary hæmorrhage in high altitudes. The writer has always maintained and still holds that there is no cause for fear if proper precautions are taken as to extreme elevations and the character and stage of the disease existing in the lungs, *i. e.*, that there should be no spots of softened lung tissue (especially near the root of the lung) which are insufficiently protected by Nature's great conservative process—the deposition of fibrous tissue. Only those patients should be sent who can bear the expansion and augmented circulation without rupture of blood-vessels. In portions of lungs where there is no softening this increased pressure acts on the distended vessels as a properly adjusted bandage does on a swollen limb. The alternate crowding of the dry air against hypertrophied or diseased alveolar walls, and the suction directly applied through the push given to the circulation, tends to clean out the products of morbid processes and relieve congestion. There is, as mentioned by Dr. C. T. Williams, "first, hypertrophy, or more complete development of certain portions of healthy lung tissue; second, emphysema of other portions, especially of those in the neighbourhood of the consolidations and cavities." * This increased action and the dilatation help to isolate caseous or tubercular portions, prevent the spread of infection, and promote cicatrization or fibrination of these affected parts.

In very acute conditions we are "on the other side of the fence," and it is *rest* which is needed; therefore experience in high altitudes naturally leads to the appreciation of using restraint to chest movements in pneumonia. The cotton jacket, with pressure to the limit of comfort, is used by the writer in catarrhal or broncho-pneumonias of children, which are more apt to occur during extremely cold weather in high altitudes.

As to pneumonic and hæmorrhagic cases, the writer's later experience (and it has been considerable) tallies well with that tabulated in his report to the International Medical Congress of 1876, in which records were presented of 202 consumptives who had spent a total of 350 years in Colorado. The pneumonic cases and the hæmorrhagic (without cavity) were by far the best influenced of all varieties.

4. The question of an altitude of immunity from phthisis is important, because there is presumptive proof that those climatic conditions which prevail where phthisis seldom or never originates are best suited to arrest the disease when it has commenced elsewhere. Reference must be briefly made to the considerable evi-

* *The Treatment of Phthisis by Residence in High Altitudes.*

dence of medical writers in favour of an altitude of approximate immunity from phthisis, which, with us in America, ranges not far from 8,000 feet in the southwestern part of the United States to above 4,000 on our northern boundary.* As to the quality of the climate which affords this immunity, Jaccoud says: "Altitude is the most important element. . . . Climates with a high altitude, having tonic and stimulating effects, can alone confer on the inhabitants absolute or relative immunity from pulmonary phthisis." While altitude is the governing element, all the associated favourable conditions of the atmosphere, somewhat in the order in which we have named them, seem to go hand in hand until they reach the climax of success in conferring a more or less complete immunity from consumption upon the residents at the given altitude. In illustration of this influence, the records of the mortality from phthisis in the city of Denver and in Colorado generally might be cited. Out of 20 deaths from this disease, 18 or 19 are from the imported cases, a fact which should always be taken into account as explaining the considerable mortality from phthisis in this State.

IV. *Why Sunshine is Superior to Cloudiness.*—There is little necessity of advocating the utility of sunshine. Proof is sufficient, but it is necessarily combined with that of other climatic attributes. Everybody acknowledges the benefit of sunshine, though in summer time he may have a personal preference for shade. Undoubtedly the effect of light upon man's physical and moral well-being is analogous to the fructifying influence of the sun's rays upon the vegetable kingdom. All life depends upon sunshine, and for successful existence must have it. The proportion of sunshine to cloudiness depends on the length of the day, on the exposure of the place, on whether or not it is concealed in a valley, and on the cloudiness of the sky. The distribution of clouds in the United States is computed by the Signal Service Bureau in tenths of obscuration of the sky, and from these observations the percentage of cloudiness, and conversely of approximate sunshine, may be noted for the whole country. Reference is made to the first of the coloured charts in the *Climates of the United States* already referred to for an eleven-year average of the distribution of cloudiness. The variations of cloudiness range from above 60 per cent. of the time over the interior lake region down to less than 30 per cent. in the southwestern portion (New Mexico and Arizona). Taking so broad a field into calculation, a striking harmony is noted between cloudlessness or sunshine and the other favourable attributes. They all go together. A preponderance of sunshine should be mentioned as favouring the possibility of the much-to-be-desired outdoor life, and also of the camping-out idea in summer time.

V. *Why Variability can be substituted for Equability.*—How uniformly variability goes with dryness and equability with moisture, may be illustrated by the daily and monthly ranges of temperature at places which represent dry and moist climates. Chosen without reference to this particular evidence, twenty-five dry and twenty-five moist prominent signal stations and health resorts in the United States give the following means:

	Means of daily ranges.	Means of monthly ranges.
First, extreme dryness……	36·51° F.	53·65° F.
Second, moderate dryness…	20·63°	49·38°
Third, moderate moisture…	17·09°	45·48°
Fourth, extreme moisture…	13·61°	41·55°

Again taking the fifteen most and the fifteen least variable signal stations in the United States for a year (out of 136 stations), we have the following daily ranges averaged by seasons:

FIFTEEN STATIONS.	Spring.	Summer.	Autumn.	Winter.	Year.
Most variable……	30·7°	29·1°	28·4°	28·5°	28·7°
Least variable…..	12·2°	12·9°	10·8°	12·0°	11·9°

The first fifteen are extremely dry, and the second fifteen decidedly moist localities.

Seasonal ranges of temperature likewise show the inseparability of equability from atmospheric moisture and of variability from dryness. Compare the winter and summer lines on seasonal charts. The sea is the great equalizing influence, and the colder land in winter turns these isotherms to the south for a considerable distance in the United States—viz., about parallel with the Pacific coast. In the summer, however, when they leave the ocean, these lines are turned nearly as much to the north as the winter ones are to the south. The farther we get away from the humid influences, the greater is the variability of temperature. It is not maintained that extreme variability should always be sought for, or that of two places with all other advantages the same the more variable one is the better. On the contrary, the less variable would certainly be preferred in cold weather. It is maintained, however, that variability is quite a uniform constituent of dry, high places, and that as the dryness predominates the marked variability is less felt, and is less, if at all, objectionable. On the other hand, marked atmospheric equability, wherever found, is *prima facie* evidence of excessive humidity.

The worst that can be said against combining variability with the favourable attributes of climate for phthisis is that its defence is necessary, because it is a *sine qua non* of the preferable combination. Very well. But there would be no excuse for advocating a false theory of climate, even if this one element were unfavourable. There is a prevalent exaggeration of the effect of temperature changes. The change gets the blame which rightly belongs to the

* Jourdanet's *Le Mexique et l'Amérique tropicale.* Dr. Weber's *Climate of the Swiss Alps.* Dr. S. Jaccoud on *The Curability and Treatment of Pulmonary Phthisis*, pp. 286-295. The writer's *Rocky Mountain Health Resorts*, p. 94. Among other authors who have furnished proofs of an altitude of immunity the following should be included: Dr. H. C. Lombard, Dr. C. T. Williams, Dr. Küchenmeister, Dr. Bremer, Dr. Archibald Smith, Dr. Fuchs, Dr. Nubry, Dr. Spengler, Dr. Kirsch, and Dr. Guilbert.

element of *humidity*, which constituent is always excessive when a given change is injurious. For instance, a change of 20° from a warmer to a colder temperature, with the relative humidity 50 per cent., does not equal in the sensation or shock to the system a change of 8° with the relative humidity at 0·80. The former change does not produce saturation, but the latter does; so does a change of 5° with the humidity at 0·90, and even 2° with the humidity at 0·95 (see Glaisher's table).

Therefore it is the humidity of the air which, through conduction of heat from the body, makes a slight temperature change, with the air near saturation, equivalent to a much greater change with the air dry. It is one of the mistakes of medical antiquity for equability to be insisted on as a constituent of the best climate for phthisis; yet this seems to be a fallacy, held by some writers to the present day, most difficult to correct. It is all right and essential to insist upon equability for humid climates but for dry, cool, and elevated resorts it is out of the question. There is something wrong with the reasoning powers of an author who jumbles together climatic attributes so that his "ideal climate" has no real counterpart among the known climates of the world! The trouble is chiefly with the vague use of the words "equability" and "variability." There has been no accepted line of definition between these two terms. If the mean of variability for the whole country were taken as a just division, and the daily and monthly ranges of temperature were the criterion to decide by, we should then have a division line approximately represented by 18° to 20° F. for the daily, and 46° to 48° for the monthly range, the same being in harmony with the dividing line between moisture and dryness on the writer's charts. This is a fair line of division which is commended for the use of writers who think *equability* an essential for pulmonary health resorts.

Besides the quality of stimulation which is associated with variability, there is an important consideration in the purifying of the atmosphere which variability indicates. This happens through the alternate expansion of the air by heat and its contraction by cold, together with the nightly chilling and sometimes freezing, which regularly render it inimical to germ life. The purity of atmosphere which is represented by warm, moist, and equable climates is not to be compared with that purity which is represented by the opposite attributes. The first is where the temperature so continuously hovers within the limits of the microbe's needs, where sound as well as heat is smothered within a short distance, and the sun's rays give a dusky-red glow. The second, indicating a comparative absence of germs, is where exposed meat can cure and not spoil, where far-distant objects appear near, and where the unobstructed rays of the sun give nearly as white a light as an electric lamp does.

VI. *Why Diathermancy is to be preferred to Dense, Moist, or Smoky Atmospheres.*—This diathermancy is the clearness or transparency of the air, which is a decided indication of its purity. It is with the atmosphere as with water. The larger the lake, with perfectly clear water through which one can see to a great depth, the better is the evidence of purity. So a large area, having throughout a similar atmosphere, through which one can see to most remarkable distances, and besides, probably, be deceived as regards the same, must indicate, as its coldness, rarefaction, and dryness do, that the purity is approaching the absolute. This increasing purity of atmosphere—that is, the absence of dust or smoke, or of moisture with its attendant infusoria—is a decided feature of elevation, because with each rise of 1,000 feet an equivalent stratum of air has been left down below, and, according to Prof. Tyndall, each higher successive stratum contains less and less of infusoria. Prof. Miquel, of the Observatoire de Montsouris, near Paris, has achieved a result in the analysis of the air which, as mentioned by Dr. Poore in his Cantor lectures, is very interesting in this connection.* Miquel found the following numbers of bacteria in ten cubic metres of air taken as nearly as possible at the same time at the respective places: At an elevation of from 2,000 to 4,000 metres, none; on the lake of Thun (560 metres), 8; near the Hotel Bellevue, Thun, 85; in a room of the Hotel Bellevue, Thun, 600; in the Park of Montsouris (near Paris), 7,600; in Paris itself (rue de Rivoli), 55,000. These figures, in whatever way they are studied, are certainly suggestive of the fact that atmospheric purity, in so far as its aseptic nature is concerned, keeps pace with diathermancy. A rule for the average change in diathermancy, for each rise in elevation, was devised by the writer in 1876 from consecutive observations of the sun temperature at 2 P. M. and at different elevations.† It is as follows: *For each rise of about 235 feet there is one degree greater difference in temperature between sun and shade at 2 p. m., as shown by metallic thermometers.*

An attempt by the writer to graphically illustrate the distribution of soils in the United States on the basis of their absorbent or moisture-retaining proclivity was met by many obstacles. Such work pertains rather to the duties and obligations of the Government. This much, however, is evident: that the distribution of atmospheric moisture closely coincides with that of soils. The dry soils, the rocky and sandy portions of mountainous configuration, and the dry, sandy loams, with rapid absorption of air vapour and radiation of heat, nearly represent the dry sections, atmospherically speaking. *Per contra*, the clay soil and marshes of level sections, with their moist cold and the easy solution of organic emanations, are closely associated with the moistest atmospheres, excepting where there are humid currents from over large bodies of water or extensive marshes. This correspondence with reference to broad areas becomes strong proof of the utility of our preferable combination of climatic attributes.

A *mountainous* country, aside from the benefit of elevation above the sea, has many ad-

* *Chronic Pulmonary Phthisis*, by Hermann Weber.
† *Rocky Mountain Health Resorts.*

vantages over a level region. Chief among these are the quick drainage, which allows of no detention of stagnant water; the greater surface of the earth exposed to absorb atmospheric moisture; the many faces of rocks, etc., favouring radiation of heat and reflection of light; the element of stimulation, both atmospheric and electric; the controlling of severe winds; the variations of scenery, temperature, and exposure afforded; and the facility with which one can indulge in the usual "climbing treatment" and pleasurable outdoor activities. When these advantages are compared with the moisture-retaining properties, the sameness, the "siroccos," the trade winds, and the "northers" of level regions, there is not much difficulty in choosing between them.

The changes in the atmosphere in consonance with the variability of temperature of mountainous places are in no small degree *electrical*. There is an increase of electrical tension and there is an easier and more frequent interchange between the positive electricity of the dry air and the negative quality of the ground and of clouds, so that the condition is decidedly stimulating. This quality in mountainous sections is associated with light showers, especially in summer time, when they are most needed to clear the atmosphere. The simultaneous whirl of a light or rapid wind often seen at great altitudes purifies by its substitution of an unused and fresh supply of air for that which is contaminated. Where people crowd together in large numbers, the daily freezing of the air is the only sufficient substitute for the movement which is caused by a mild wind. We thus arrive at the conclusion that, in densely settled sections, *continuous stillness of the atmosphere is only to be preferred in the freezing weather of winter*. In other words, the warmer the atmosphere the more is air movement desirable.

It is where there is a total absence of land influence, as in sea voyages and on islands far out at sea, or on dry, sandy coasts, with favourable sea winds prevailing, that low climates may if necessary, be substituted for high ones. The malarial and organic emanations from the soil, which are a fruitful source of increased mortality from phthisis (Buchanan and Bowditch), are thus excluded from the climatic calculation. The aseptic condition of the atmosphere out at sea (Miquel), its quality of stimulation, and the tonic effect of the change, with the invigoration of all the bodily functions, including the improvement of appetite and digestion, are all akin to the best effects of high climates, though the elimination of septic germs is less perfectly performed. Evidently being out on a sea voyage *under favourable conditions* is next in advantage to being at a well-chosen high-altitude resort for a great many pulmonary invalids, and for a few selected ones even better, for reasons which will be apparent farther on. The great difficulty is in securing the "favourable conditions."

The *evidence of experience* is in harmony with what might be expected from a consideration of these favourable climatic attributes. The chief difficulty is our inability to make use of statistics of lowlands which are fair for comparison with those which have been tabulated for high-altitude stations. As to the latter, explaining that the term "cured" ought, perhaps, instead to be stated as *more or less permanently arrested*, and that the records given embrace only those of all the patients treated during a given short period by any of the observers, then the following table, taken from Dr. Solly's paper on The Personal Equation in the Treatment of Phthisis, gives a very clear idea of the favourable results in both the Alpine and the Colorado high altitudes:

ELEVATED CLIMATES (4,500 FEET AND UPWARD).

All Stages.

REPORTED BY	No. of cases.	Cured.	Benefited.	Where treated.
		p. c.	*p. c.*	
1. Dr. Hermann Weber	106	36	75	Swiss Alps.
2. Dr. Theo. Williams.	141	41	75	"
3. Dr. H. A. Johnson..	19	37	79	Colorado.
4. Dr. Charles Denison	202	37	80	"
5. Dr. S. A. Fisk......	100	35	67	"
6. Dr. S. E. Solly......	141	33½	67½	"

First Stage.

REPORTED BY	P. C. of cases.	Cured.	Benefited.	Where treated.
		p. c.	*p. c.*	
1. Dr. Hermann Weber	66	51½	64	Swiss Alps.
2. Dr. Theo. Williams.	65	63	90	"
3. Dr. H. A. Johnson..	47	44½	78	Colorado.
4. Dr. Charles Denison	37	75	92	"
5. Dr. S. A. Fisk......	42	66	90½	"
6. Dr. S. E. Solly......	44	58	87	"

In conclusion, it is apparent that there is nothing more *evident* about this discussion than that the element of *altitude* is inseparable from the best climate for phthisis. The natural question then follows, What is the limit up to which this combination of qualities can be carried that the best results may be obtained? This is a question of *individual adaptability*.

The best method of conclusion is to determine what conditions or diseases are suitable for the extreme of the preferable combination of attributes, and then arrive at modifications or rejections of the high-climate cure by a system of *exclusion*. This is the position always held by the writer,* and he is pleased to see the confirmation of it by the extended experience of Jaccoud as given in his late work on *The Treatment of Phthisis*. Jaccoud's conclusions are in the main correct, but it must be borne in mind that they, like those of Tucker, Wise, and Hermann Weber, and most of C. Theodore Williams's, pertain to a more northern latitude than we reason about in the United States. In the Engadine, Switzerland, the limit of timber growth is at or below 8,000 feet elevation as compared with a similar limit at or above 11,000 feet in Colorado. Here the gradual rise, the distance from the sea, and the pe-

*"Lessened barometric pressure (25 to 24 inches) being an important condition of successful climatic treatment, a resort to a well-chosen elevated climate should constitute a part of the physician's advice to every consumptive who can follow it and for whom the elevation is not specially contra-indicated."—*Rocky Mountain Health Resorts*.

culiar protection from our interior altitudes, make the change from low levels less severe. Also we in America have an increased advantage over most European high climates in that we keep up the curative effect by suitable increase of altitude in summer. Instead, they are compelled, as at Davos, St. Moritz, etc., to give up the chosen climatic treatment during the warm weather.

The plan of deciding if the preferable climate can be made use of in a given case by *exclusion because of negative conditions* will not be readily accepted by the over-zealous advocates of low climates. This is perhaps because, generally speaking, the more reasons there are for exclusion from the better climate the less likelihood is there of an ultimate recovery. This is undoubtedly true; besides, sometimes it is not an easy matter to decide what change of climate a given patient shall have, because of the many varying considerations to be weighed both as to the patient and as to the climate. I may only summarize by saying that the preferable climate for the great majority of consumptives in the United States varies, according to the case, between 1,500 feet elevation in the North in winter and 10,000 feet as a possible extreme in the southern portion in summer. As to patients, not omitting social and economic bearings, they vary all the way from those whose cases are hopeless to those that are likely to prove curable. There must then, of necessity, be many very delicate and intricate questions to be decided by the attending or consulting physician. Of course, then, any rule of procedure must be susceptible of much variation, and the physician who takes the most factors into account and weighs them best will be most successful in the management of each individual case. With this broad proviso I will state some general reasons why a given invalid may not go to an otherwise preferable climate. Assuming that he can relinquish home and business cares and is financially able to remain from four months to two years away from home, or, better, perhaps, make a permanent residence where he recovers, or in that vicinity, then the following are what we may consider as *possible contra-indications* to a climate above 5,000 feet elevation, such as that along the eastern base of the Rocky Mountains from Wyoming through Colorado into New Mexico and northern Arizona:

1. The coldest season of the year, intensifying the effect of altitude too much for those coming from much warmer climates.

2. Advanced age of the individual, rendering acclimatization difficult; senile phthisis; and the fact that the patients are too old and feeble to exercise out of doors.

3. A very excitable, nervous temperament, aggravating the stimulation of climate, producing irritability, and sometimes wakefulness, "erethistic phthisis."

4. The state of some women, because of a greater susceptibility and lesser adaptability to the change and to outdoor life than men have.

5. Valvular lesions, with rapid action of the heart, especially with the previous exceptions. Diseases of the great vessels, such as aneurysm.

6. Marked and extensive emphysema, pneumothorax, and hydro-pneumothorax.

7. Active pneumonia and existing hæmoptysis. If the pneumonia or hæmorrhage is recent, the contra-indication amounts to little; if remote, to nothing. If there is reason for some doubt in any such otherwise favourable case, a gradual rise in elevation should be advised.

8. High bodily temperature, whether it is rather constant, as in some inflammatory states or in catarrhal extension beyond a tubercular zone, or whether it is regularly vacillating, as in a tubercular infection—*i. e.*, daily low or subnormal in the morning, and up to 103° or more later in the day, especially with a suspicious laryngeal complication, as in so-called "catarrhal phthisis."

9. Extensive involvement of lung tissue in diseased action—*i. e.*, so that the healthy spirometrical record is more than one half abridged. Of course an advanced stage of disease renders this contra-indication much stronger. Dr. C. Theodore Williams, in his *Treatment of Pulmonary Consumption by Residence at High Altitudes*, expresses this contra-indication as follows: "Phthisis with double cavities, with or without pyrexia; cases of phthisis when the pulmonary area at low levels hardly suffices for respiratory purposes."

10. The stage of softening, if accompanied by daily fever, or in one of a decided hæmorrhagic diathesis. "Quick consumption," with or without intestinal ulceration or albuminuria.

A proper estimate and consideration of these ten *possible* modifiers of the high-altitude prescription tend greatly to give the physician confidence of success in sending to well-chosen elevated regions incipient and first-stage tubercular pulmonary invalids, especially in hæmorrhagic or inflammatory cases without pyrexia; persons not too old and of fair resisting powers; also those with advanced or third-stage disease with a unilateral cavity already well protected by a conservative fibrosis. If asthma (not emphysema) complicates an otherwise favourable case, Colorado experience has fully demonstrated the desirability of the change if the case is properly diagnosticated beforehand. A correct diagnosis must be insisted on as a condition of success, for the physician of much experience in high-altitude resorts has to acknowledge that too many failures or limited recoveries can be accounted for by a previous neglect to duly estimate a lung disease as farther advanced than it had been announced, or to sufficiently recognise the damaging associations of mixed infections, such, for instance, as arise from other blood taints than tuberculosis, or from the coexistent or causative effect of fermenting blood states due to dyspepsia, or from the non-elimination of effete material, as in young women with amenorrhœa with or without constipation.

Allowing patients to go to high altitudes, which many physicians have done, as a *dernier ressort*, when they have not a five-per-cent. chance of living six months anywhere, needs our strong condemnation. It must always be remembered that every rule has its exceptions,

and that contra-indications may be neutralized by favourable circumstances, such as the best time of year for the change, previous experience of the individual in high climates, and the association of opposite conditions in the same patient.

Sea Voyages.—I have adverted to the tonic effect and stimulating character of sea air as being not very unlike those of high altitudes in their results upon invalids. There is a difference of opinion among writers as to sea voyages and their effect upon the phthisical. Dr. Walshe, Dr. Charteris, Dr. Gilchrist, and others place a high estimate upon this remedial means; while Rochard proved by the mortality statistics of the French navy that phthisis was a common cause of death and that the disease consumption was more prevalent in the navy (mostly in the tropics) than in the French army. In harmony with the line of argument which I have heretofore adopted, the question is (since moisture can not be excluded at sea): Are the sea climates cool or cold, and so stimulating, or are they very warm, and so debilitating? The latter was the case with the French navy. This agreed with much other evidence obtained from statistics of voyages in different climates. The rule is that "the tropics should be avoided by natives of colder and temperate climates, especially by the young and weakly and those suffering from chronic disease." The same author, Dr. Williams, writes: "About sea voyages in general it may be said that if the weather be fine and the patient able to remain on deck, the circumstances are very favourable, as under no other conditions could he procure so much fresh air; but in stormy weather, confined to his cabin, which is always small, often unventilated, with portholes closed and hatches battened down, a different state of things prevails, and even in moderate weather he can not be always on deck, and seldom gets sufficient exercise." In the tropics the skin is overworked, and the kidneys appear to suffer, while the fact that the lungs are worked more in the temperate regions goes to confirm what we glean from the facts—namely, that the cooler climates at sea are far preferable to the warm or tropical ones. Many instances of improvement of invalids while on the voyage from England to America have been known to the writer. Dr. C. Theodore Williams kept an account of 65 phthisical patients, who took in all 118 sea voyages, 48 of whom went to Australia and back, round the Cape of Good Hope. The *general* results were good, and there was improvement in 77 per cent. Gain in weight (the usual result of sea voyages) was one of the evidences of improvement in most of these cases. The *local* results, however, while better than those in consumptives in the Riviera, especially for excavation cases, were not, on the whole, equal to the favourable results obtained in the high-altitude treatment—that is, the appearances seemed deceptive, as "the disease of the lungs may steadily progress." He concludes that sea voyages may be recommended in the following cases:

1. *Chronic pleurisy* and *chronic empyema.*
2. *Chronic bronchitis.*
3. Various forms of *scrofulous disease*, including scrofulous phthisis.
4. *Hæmorrhagic phthisis.*
5. *Tuberculous excavation*, where the cavity is limited and the disease unilateral.
6. *Neuroses*, the result of overwork, and especially *insomnia.*

The Seasons.—These natural divisions of climate of necessity largely govern the journeyings of invalids, the times of going as well as the choice of destination.

The lack of space here to introduce them and the need of the advising physician to have on hand an ever-ready reference book of all important seasonal weather records lead the author to refer for all these data to his seasonal-humidity, temperature, rain, wind, and cloudiness charts of all United States Signal Service stations (including the health resorts generally), as given in *The Climates of the United States in Colours*, previously mentioned.

This question of the seasons of the year is one of no small importance, notwithstanding the general truth that the best time for a person to go is when he *has to* because of beginning lung trouble, and not as a *last chance.* For one who really needs the change there is no time better than *the present.* The season of the year does not produce so much difference in the indications for a given invalid's hastening away as the advance of the disease from incipiency or the first stage to the ominous second stage, when the lung is "going to pieces." While the summer is by far the preferable season in our mountains, and the autumn is a good season in which to get acclimated to a given high altitude before cold weather comes on, yet many maintain that the best results obtained by those suited to the rarefied-air cure are obtained in the winter season. On the other hand, others not so well suited, such as neurotic persons, those unable to exercise because of advance of disease or extensive fibrosis leading to marked deficiency in oxygenation, or those with too sensitive mucous membranes to stand the cold, stimulating, and dry outdoor air, do well to modify the effects by going to southern New Mexico, Arizona, or California, as the indications may be, during the months from November to April.

I can not here describe the many excellent medium-altitude resorts which invalids may choose as compromise climates (perhaps temporarily indicated), such as the Adirondacks, Asheville, N. C., Lookout Mountain, Tenn., and the western portions of Nebraska, Kansas, and Texas. Much that has been said favourable to higher altitudes is also applicable to the sections named—between 2,000 and 3,000 feet above sea level.

For those who have means, the consideration of the season of the year may make desirable the adoption of a course which in some cases is quite successful—namely, to get the advantage of gradual acclimatization and approach the high altitude by degrees. For such persons, coming from the Eastern or Middle States, a good plan is to journey south in win-

ter and early spring, and go to western Texas, southern Arizona, or southern California for a sojourn till April or May, calculating then to reach some of the elevated resorts in the interior, along the eastern or southern slopes of the great "backbone" of the continent.

The time to remain in a climate in which recovery seems to have taken place is a more delicate question to handle than is generally considered. This is because tuberculosis is apt to be rendered latent by the climatic treatment and by Nature's healing plan—the fibroid process. It is often essential not only that a patient should remain permanently in the new immunity climate he has reached, but that he should adopt a new, an out-of-door active occupation, in order to obtain the best results. In less urgent cases the patients, encouraged by the absence of all physical signs of disease and by a gain in weight, if they show normal records by the spirometer and manometer, may return to their former homes to live with comparative safety. Many, however, find themselves self-deceived when they return to their old haunts and confined occupations.

Tuberculosis—and that is what is at the bottom of most of these chronic pulmonary ills—is rendered latent by the process of fibroid healing in the lungs, whether this is promoted by diet, by exercise, or by climate. These are the three principal agencies of relief thus far discovered, and the individual has the same fight to go over again (it may be with a more unfavourable outlook) if he does not accept and act upon the lesson of experience. His occupation, his habits of life as to exercise and feeding, his climate, must thereafter coincide with what he has found to be most beneficial in his health-seeking sojournings.

There are many conditions of disease and necessities of the patient which have to be left to the judgment and trial of the attending physician. And there are differences in localities and peculiar advantages and comforts, no doubt, near home which may lead to a modification of the best selection of climatic attributes.

It is, however, hoped that enough of both fact, argument, and experience has been presented to show that it is *the adaptation of climate to the individual's needs* which is desired, and that in the great majority of cases of phthisis this will be most successfully accomplished in the dry, cool, rarefied, sunny, clear, and pure, though variable, atmosphere of a well-chosen high altitude.

CHARLES DENISON.

CLOVES, *caryophyllus* (U. S. Ph.), *caryophyllum* (Br. Ph.), *caryophylli* (Ger. Ph.), are the dried unexpanded flower-buds of *Eugenia aromatica*. There are numerous oil glands under the epidermis of the clove, and 18 per cent. of the substance of the clove is volatile oil. Beside this, it contains, according to Maisch, 13 per cent. each of tannin and gum, 6 per cent. of a tasteless resin, and wax, caryophyllin, $C_{10}H_{16}O$, and eugenin, $C_{10}H_{12}O_2$. According to H. Thoms, oil of cloves has a specific gravity of from 1·060 to 1·065, and consists principally of eugenol, a phenol having the same formula as eugenin. The quantity of this substance that is contained in oil of cloves may be taken as a measure of the value of the oil; the oil contains also a sesquiterpene, $C_{15}H_{24}$. Professor Jorissen and E. Hairs (*Pharm. Jour. and Trans.*, 1893–'94, p. 261) isolated from the oil a substance that closely resembled vanillin in its physical and chemical characteristics. Caryophyllin occurs as white, tasteless needles, and eugenin as pearly scales.

Oil of cloves, *oleum caryophylli* (U. S. Ph., Br. Ph.), *oleum caryophyllorum* (Ger. Ph.), is a pale yellow, thin, volatile oil distilled from cloves, possessing the characteristic odour of cloves and a pungent, spicy taste. The oil becomes darker and thicker in the course of time. It is seldom administered internally, but has been used to allay *toothache*, being inserted into the cavity in cases of *dental caries*, also, applied on a pledget of cotton, to relieve *earache*. From the oil neutral acicular crystals of benzoyl-eugenol have been obtained, and their use has been recommended in the treatment of *tuberculous affections;* also cinnamyl-eugenol, colourless, odourless, tasteless crystals that are used in tuberculous conditions; and eugenol-acetamide, a patented anæsthetic.

Powdered cloves are stimulant and carminative, and in this way have a slight influence in promoting digestion. The dose of cloves is from 15 to 60 grains; that of the *infusum caryophylli* (Br. Ph.) from 1 to 4 fl. oz. Externally, cloves, heated and moistened with alcohol, are applied as a spice poultice to the epigastrium to relieve *nausea* or *vomiting*.

Manotti (*Therap. Gaz.*, 1891, p. 431) found that tincture of cloves retarded the development of the *Bacillus tuberculosis*, and he treated a number of cases of *local tuberculosis* with injections of a 10-per-cent. emulsion of cloves in olive oil into the tuberculous region. He stated that *cold abscesses* were greatly improved by these injections, which were also more useful than iodoform emulsions for the treatment of *fungous arthritis* and *tubercular adenitis*. J. Kanasz (*Therap. Gaz.*, 1892, p. 838) employed a 10-per-cent. solution of essence of cloves in olive oil in the treatment of local tuberculosis. From 30 to 300 drops were injected at intervals of a week, the time depending upon the rapidity with which the oil was absorbed, and fungous arthritis and tuberculous glands were benefited by the treatment.

Eugenol, or eugenic acid, is a powerful antiseptic, and has been used for this effect by dentists. It produces slight anæsthesia when applied to mucous membranes. It has been used, in a lanolin ointment, in *eczema*.

SAMUEL T. ARMSTRONG.

CLYSTERS.—See ENEMATA.

CNICUS BENEDICTUS.—See CENTAUREA BENEDICTA.

COAL TAR, a dark, thick liquid obtained in the dry distillation of coal, is the source of many medicinal substances, which will be found treated of under their own heads. Coal tar

itself, mixed with 20 parts of plaster of Paris, is used in veterinary practice as an antiseptic application to *foul wounds* and *ulcers*. A saponaceous compound, the *coaltar saponiné* of the French, used for the same purposes, is a liquid made by mixing 1 part of coal tar with 2 parts of black soap and adding, with gentle heat and stirring, 1 part of alcohol and 24 parts of water.

COBALT is a metal which is found in combination with arsenic and sulphur. Its salts are usually red when they are hydrated and blue when anhydrous. Cobalt and its salts are poisonous, killing by paralysis of the respiratory centre in the medulla oblongata rather than, as Brunton has said, by arrest of the action of the heart. In smaller doses they cause slight contraction of the blood-vessels. Dr. D. J. Leech (*Brit. Med. Jour.*, 1885, ii, p. 1005) found that cobalt yellow, a double nitrite of cobalt and potassium, was irregular in its action; in some individuals 3 or 4 grains produced very little fall in the blood-pressure, while in others 4 grains lowered the tension for three hours and 7 grains lowered it for six hours; the duration of its action was not greater than that of the other nitrites.

Buchheim and Buchner have reported that small doses of cobalt salts are not poisonous. Cobalt chloride in 10-grain doses given to a dog by the stomach or endermically produced vomiting, and 6 grains, intravenously, caused death; 6 grains of cobalt sulphate injected into a rabbit's stomach killed the animal in a few hours. Huseman found that cobalt oxide in 30-grain doses caused the death of dogs in a few hours. In regard to those experiments, it has been said that the cobalt was impure in consequence of the presence of arsenic, and that the phenomena produced were the results of arsenical poisoning; so Siegen experimented with cobalt nitrate and cobalt chloride which were absolutely free from arsenic, and found that $\frac{1}{6}$ of a grain of either of these substances would kill a frog in half an hour, and $\frac{1}{2}$ a grain would kill a strong rabbit in three hours.

Dr. T. P. Anderson Stuart (*Jour. of Anat. and Phys.*, 1882–'83, p. 89) found that after injections of cobalt carbonate into the dorsal lymph-sac of frogs the colour of the skin of the body became darker; there were fibrillary twitchings, first in the muscles of the abdomen, then in those of the fore limbs, and finally in those of the hind limbs; spasmodic gaping and motor inco-ordination occurred, succeeded by clonic and tonic convulsions, which were followed by stupefaction. The heart beat more slowly and feebly, the respiratory movements ceased altogether, and death gradually ensued. He found that cobalt had no appreciable effect on striped muscle; that it paralyzed the cerebrum to some extent, and that it had no effect upon the blood-corpuscles. In warm-blooded animals there is greater motor excitement when the salt is injected into the blood than when it is administered subcutaneously; this is followed by the discharge of urine and fæces and by violent retching and vomiting. The heart beats rapidly, strongly, and regularly, the breathing is deep and rapid, there may be contraction of the pupil, and the retching continues. After large doses the respiratory movements become longer and more laboured, convulsions supervene, and then respiration fails, although the heart may continue beating for some time after the cessation of the respiratory movements. After non-toxic doses there may be a persistent serous diarrhœa, stomatitis accompanied by difficulty of chewing and swallowing, loss of appetite, great thirst, blackening of the teeth, softening of the gums, and the emission of a foul odour from the mouth or gaseous eructations from the stomach. The urine becomes of a rich brown colour, and this persists until the cobalt is excreted; this coloration is not due to blood-pigment. Post mortem, inflammation of the entire alimentary tract and small hæmorrhagic extravasations in the endocardium and epicardium are found.

In case of poisoning by cobalt, we should empty the stomach by a hypodermic injection of apomorphine, and give warm mucilaginous drinks and hypodermic injections of strychnine.

[Cobalt has been but little used in medicine. An *oxide*, prepared by precipitating the chloride with potash, has been used in *rheumatism* and, in doses of from 10 to 20 grains, as an emetic, but the published reports upon its action are inadequate to justify its recommendation.

Potassium cobaltonitrite, $Co_2(NO_2)_{12}K_6 + 2H_2O$, has been used by Dr. J. West Roosevelt (*N. Y. Med. Jour.*, Aug. 25, 1888, p. 197) in cases in which other nitrites are often indicated. To prepare the salt, a solution of potassium nitrite is mixed with a solution of a salt of cobalt, previously acidulated with acetic acid; the result is a crystalline precipitate varying in colour from bright yellow to a dull olive shade. Dr. Roosevelt used the potassium cobaltonitrite at the suggestion of Dr. Wolcott Gibbs, who thought that, on account of its stability and relative insolubility, it would probably cause a slower, more uniform, and more easily controlled action than that of nitroglycerin, sodium nitrite, amyl nitrite, or ethyl nitrite. The dose was $\frac{1}{2}$ a grain every two, three, or four hours, in a few cases every hour. Among the patients there were three with *uræmia*, *high arterial tension*, and *dyspnœa*. The tension fell in from fifteen minutes to an hour. In two of the cases the dyspnœa was wonderfully relieved, and in one of them, in which the cobaltonitrite was given alternately with nitroglycerin, the patient felt positive that the relief of dyspnœa was more lasting from the cobalt salt than from the nitroglycerin, and that it produced no fulness, throbbing, or pain in the head, while nitroglycerin had caused a great deal. In another case in which the two drugs were given alternately, neither seemed to give much relief, and there was vomiting after the use of the cobalt salt was begun, but Dr. Roosevelt thinks it uncertain whether this was due to the cobalt or to the uræmia. In the third case the cobalt gave absolute relief from dyspnœa and produced neither headache nor vomiting. Dr.

Roosevelt regards his experience in the use of the cobaltonitrite as encouraging. The salt, he remarks, is easily prepared, cheap, stable, and safe.]—SAMUEL T. ARMSTRONG.

COBWEB.—See ARANEA.

COCA AND COCAINE.—*Erythroxylon coca* is a small tree that grows wild in various parts of South America. The chief supply is from plantations established in Peru, Ecuador, Bolivia, and Brazil. It is from the leaves that the potent principles are derived. These are collected in enormous quantities at harvest-time, which in some localities may occur two or three times a year.

At the time of the conquest coca was found to be in general use among the natives of Peru, who were in the habit of chewing the leaves with a small quantity of vegetable ashes, for the purpose of combatting the fatigue engendered by manual labour and protracted marches. Most travellers, whether of an early or later period, who have been in a position to study the effects of the plant upon the natives as well as themselves join in extolling its virtues as a remedy against the exhaustion incident to excessive physical and mental exertion.

In addition to these qualities of erythroxylon, which are now thoroughly understood by the medical profession, various apocryphal virtues have been imputed to the plant by the ignorant since the days of the earliest tradition. These things possess, however, merely a legendary significance and are altogether devoid of practical interest. What most nearly concerns us for the moment is the stimulating property of the drug—a property which of late years has procured for coca an extensive use in medicine.

Briefly summarized, the effects produced by a good preparation of coca upon the organism are: 1. Mental exhilaration, resembling somewhat that observed after a considerable dose of caffeine. 2. A marked tendency to wakefulness. 3. Temporary exemption from the craving for food, but without true physiological substitution. 4. Increase of the number and force of the heart beats.

When, however, the dose is excessive, the picture becomes much amplified. The subject experiences an exaggerated sense of *bien être*, a feeling of veritable beatitude, both mental and physical, expressing itself in incoherent flights of the imagination and an abnormally acute consciousness of muscular vigour. To these may be added muttering delirium, hallucinations, especially of vision, and ultimately mania.

Coca is best administered either as a wine of coca, of which the well-known vin Mariani is typical, or in the form of the fluid extract, *extractum cocæ fluidum* (U. S. Ph.), *extractum cocæ liquidum* (Br. Ph.). In my experience, the elixir and tincture are not sufficiently active for clinical purposes.

Coca is chiefly indicated as an adjunct in the management of *neurasthenia* and *anæmia*, accompanied by moderate depression, loss of appetite, or slight impairment of digestion. It has been recommended in a host of other conditions, but this is its legitimate field.

To prevent the temporary impairment of appetite due to its slightly benumbing effect upon the gastric mucous membrane, it is usually best to give it after eating or during the latter part of the meal.

Three alkaloids, hygrine, ecgonine, and cocaine, have been isolated from coca leaves. The first, of which the chemical autonomy is doubted by some, is a liquid obtained by treating the leaves with amylic alcohol, while the second results from heating cocaine with hydrochloric acid. Neither of these substances has as yet made for itself a place in practical medicine. With cocaine, however, the case is quite different, for this substance has proved to be one of the most valuable additions ever made to the resources of medicine.

For years physicians had been alive to the necessity of finding some means of producing local insensibility for both surgical and medical purposes. Yet, plausible as some of their attempts, such as compression of the blood-vessels and nerves or congelation of the tissues, appeared at first sight, they all failed to maintain a hold upon the mind of the profession, for the good and simple reason that in one important particular they were all lacking. All the methods proposed were, if not entirely, yet practically *non-chemical*, for there was not at hand a substance which possessed such an affinity for the sensory nerves that, when brought in contact with them, it was able to suspend conduction.

Now this, as all the world knows, is precisely what cocaine, $C_{17}H_{21}NO_4$, separated from the leaves of erythroxylon in 1859 by Niemann, can accomplish.

Cocaine has a bitter taste, is but slightly soluble in water, but freely so in ether, in chloroform, in oils, in melted vaseline, etc. With acids it forms salts, most of which are readily soluble in water. Thus we have the hydrochloride, hydrobromide, citrate, benzoate, tannate, and sulphate of cocaine. The one first mentioned is probably more employed than all the others combined.

In addition to these may also be mentioned cocaine phenate, which is insoluble in water, but readily soluble in water and oleate of cocaine, which is nothing more than a saturated solution of the alkaloid in oleic acid.

Cocaine phenate has been sometimes employed in the nasal cavity and in catarrhal conditions of the stomach. The success attending these efforts has not, however, been flattering, and at the present time this preparation is not much used. It is, of course, quite unsuited for hypodermic use on account of its insolubility in water.

In 1862 Schroff mentioned before the Medical Society of Vienna that when cocaine was brought in contact with the tip of the tongue there was produced in a short time complete loss of sensibility in the part thus exposed to the influence of the drug.

One would imagine that an observation so suggestive would have produced its effect upon an intelligent body of medical men; yet for

twenty years little or nothing was heard of it. At length, however, in 1884, Dr. Karl Koller, of Vienna, now of New York, again took up the matter (*Wien. med. Wochenschr.*, Oct. 25, Nov. 1) and demonstrated in an elaborate series of experiments that the alkaloid was capable of anæsthetizing the cornea and conjunctiva as well as the tongue.

Dr. Henry D. Noyes directed the attention of American practitioners to Koller's observations in a letter published in the *Medical Record* of Oct. 11, 1884. This early notification was fortunate for the physicians of this country, for it enabled them to evolve the best means of employing the local anæsthetic long before their European colleagues had begun to make much use of the new acquisition. Thus it has come to pass that the credit for the solution of this part of the problem belongs to America. Two stages are discernible in the evolution of this practical side of the undertaking: 1. That in which the attention of the investigators was directed to the application of the drug to the various mucous surfaces. These activities represented self-evidently an extension of the observations of Schroff and Koller. 2. A period characterized by systematic attempts to apply the new local analgetic to the sensory nerves of the skin and other tissues both for surgical and for medical purposes. It soon became apparent that this second portion of the problem would make some unique demands on ingenuity.

Let us consider these two aspects of the question:

I. The Application of Cocaine to Mucous Surfaces.

Application to the Eye.—Cocaine is now universally employed in ophthalmic practice, usually in the form of the hydrochloride. Solutions of various degrees of concentration are employed, though probably most operators still give preference to one of 4 per cent. To obtain the best results repeated instillations of a drop or two should be made every ten minutes for half an hour, when the anæsthesia will have become so profound as to readily admit of the performance of such operations as that for cataract, removal of foreign bodies, iridectomy, sclerotomy, slitting of the canaliculi, tenotomy, and even, as some surgeons affirm, extirpation of the eyeball. When it is employed for the last-mentioned operation, instillation must be supplemented by subconjunctival injection in order to obtain the greatest possible degree of analgesia. In performing iridectomy, more especially for glaucoma, some surgeons are in the habit of supplementing the preliminary instillations by injections into the anterior chamber. The operation is much more likely to be a painless one when this precaution is observed than when instillations alone are relied upon.

Application to the Nose, Pharynx, and Larynx.—Since cocaine is readily absorbed by the mucous membrane of the nose, pharynx, and larynx, it is possible to perform a number of operations in those regions by means of the local anæsthetic. Removal of polypi from the larynx and nose, cutting off the uvula, scraping of the epiglottis, and the introduction of a catheter into the Eustachian tube, are all possible in this way. Some operators prefer strong solutions of from 10 to 20 per cent. for the purpose.

Application to the Genito-urinary Tract.—When a few drops of a solution of from 2 to 5 per cent. of the anæsthetic are injected into the urethra a catheter may be introduced without pain, provided there is no stricture. Lithotrity, litholapaxy, and other operations may be performed after injections of cocaine.

Application in Gynæcology.—There is considerable difference of opinion among surgeons as to the exact limitations of local anæsthesia in gynæcology. Some have not hesitated to invoke it in laparotomy, ovariotomy, and other great undertakings of abdominal surgery, but the majority of surgeons are, doubtless, still content to reserve it for the minor operations about the vulva, vagina, and uterine cavity. Grattage, cervical dilatation, the removal of polypi, excision of the cervix, and the operation for vesico-vaginal fistula have all been done under local anæsthesia. Most observers are agreed that the applications to the mucous surface of the uterus and vagina should be supplemented by injections into the parenchyma.

Applications to the Rectum.—Cocaine has been used by various surgeons in the extirpation of hæmorrhoids and in fistula. The plan usually pursued is to apply the anæsthetic to the mucous membrane by the aid of absorbent cotton saturated with a 5-per-cent. solution. Supplementary injections may also be made should circumstances seem to require it. When, however, the complications to be met with are at all considerable, it is probably better to resort to general narcosis.

Application in Dental Surgery.—In the *Transactions of the Odontological Society*, vol. xix, Mr. Hern (quoted by Buxton) enumerates the following applications of cocaine in dental surgery:

The adjustment of clamps and separators.

The introduction of wedges.

The application of ligatures for the rubber.

The manipulation of deep cervical edges of cavities, whether for excavating, filling, trimming, or polishing.

The removal of tartar in pyorrhœa alveolaris.

The modelling of sensitive and irritable mucous membranes. For this purpose a paint of a 10-per-cent. solution is used, or a spray of 2 or 4 per cent., according to the degree of sensibility manifested by the parts.

For lancing and excising gum-tissue.

For the relief of pain after extraction.

For anæsthetizing pulps before extirpation.

For obtunding sensitive dentine (results not very satisfactory).

For purposes of extraction two or three injections are made around the root of the tooth in such a way that part of the solution is placed in front and part behind the prominent ridge of the buccal alveolus. The procedure is not, however, uniformly successful, and, owing to the proximity of the point of injection to the

brain and spinal cord, the absorption of the drug has frequently been accompanied by profound constitutional symptoms.

II. The Application of Cocaine to the Skin.

To scientifically make use of cocaine in operations involving more or less extensive dissection of the integument is a very different thing from applying it to the mucous membrane.

It will be convenient to treat this portion of the subject under the two following headings: Introduction of the anæsthetic into the integument; and Perpetuation of its effects upon the peripheral nerves after introduction.

a. Introduction of the Anæsthetic into the Integument.

1. *Injection by Means of the Hypodermic Needle.*—To painlessly inject cocaine into the skin is a very simple matter, and to accomplish it one need only proceed as follows: After the proper antiseptic precautions have been observed the part is sprayed with rhigolene or, what is at present more convenient, with ethyl chloride. As soon as the insensibility induced by the refrigeration is sufficient, the point of the hypodermic needle is introduced just below the epidermis and a drop or two injected into the tissues. On withdrawing the needle and testing the condition of sensibility at the point of injection, it will be found that there is complete anæsthesia. Now, by again inserting the needle into this small area of insensibility, and as it is forced onward, injecting the solution gradually in front of the point, it is possible to inject a wide area without causing the slightest pain. Hence the ethyl chloride can be dispensed with after the first injection. It is well to make the injections in an orderly manner. Thus it is advisable to inject the subepidermal region first, and subsequently the deeper tissues.

2. *Introduction of the Anæsthetic into the Skin Endermically.*—To accomplish the endermic introduction of the alkaloid, it is only necessary to produce a small blister, withdraw the serum with a syringe, and inject in its place the anæsthetic. Both operations are readily accomplished by the aid of an ordinary hypodermic syringe provided with a fine needle. The procedure is not especially valuable, even medically; and for the induction of local anæsthesia for surgical purposes it has no practical value.

3. *Cataphoresis, or the Introduction of the Anæsthetic into the Skin by the Aid of the Galvanic Current.*—So far as I know, Sir Benjamin Ward Richardson was the first to attempt the introduction of a remedy (chloroform) into the skin by the aid of the galvanic current. This was years before cocaine was heard of. After the anæsthetic properties of the latter were made known it was but natural that attempts should be made to cause it to enter the skin by invoking the assistance of the same agent which had been used with a similar purpose in the case of chloroform. Accordingly Wagner in Europe, and subsequently I myself—for the first time in America—made use of the same principle. The method which I devised differs, however, from that proposed by Richardson and Wagner, notably in this: that I resort to preliminary painless puncture of the skin, by means of the well-known instrument of Baunscheidt, which is provided for the purpose with numerous fine needles. This is done with a view to increasing the porosity of the skin, and thus facilitating the introduction of the anæsthetic.

Without anticipating further I will give a brief account of my method, which is an improvement on that described by me in 1886* (*N. Y. Med. Jour.*, Nov. 19).

Its essential features are as follows: The region to be saturated with the chemical is first perforated by a large number of delicate needles, which are driven into the integument on releasing a spring, much after the manner of the old-fashioned spring lancet. The object of this is, as has previously been said, to increase the porosity of the skin, thus enabling the current to propel the anæsthetic into the depths of the parenchyma. It is, however, of the utmost importance to employ only the finest needles obtainable, since when coarse ones are used large openings are produced—openings which no longer belong in the category of "pores," and through which the chemical refuses to pass. Only punctures which are invisible to the naked eye, and reveal their presence solely when seen through a strong magnifying glass, fulfil the indications.

The next step is the introduction of the anæsthetic by the help of the galvanic current. In order to accomplish this we proceed as follows:

Two or three thicknesses of flannel cloth are saturated with a five- or six-per-cent. solution of the hydrochloride of cocaine. The cloth is then laid over the perforated area of the skin, care being taken to avoid folds or other inequalities of the surface. A layer of potter's clay, of a consistence to be readily fashioned to correspond to any irregularity of bodily contour, is then spread over the flannel to the depth of an inch. In this layer of clay is now embedded a thin sheet of copper. This sheet of copper is next placed in communication by means of an ordinary insulated conducting wire with the positive pole of a galvanic battery. It will thus be seen that, when the circuit is completed, the current passes through the clay electrode to the flannel, where it exercises its propulsive influence upon the anæsthetic.

As to the position of the negative pole, which should be of good size, all that need be said is that it is to be placed as near as possible to the positive pole *but without touching* the latter. A broad, flat sponge, saturated with warm water and held in place by an elastic strap, answers every purpose.

With regard to the strength of the current, much will depend upon the situation and extent of the area to be anæsthetized. Generally speaking, the greater the area the stronger

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* See also my monograph on *Pain*, Philadelphia, 1894.

must be the current and the longer must be the application. It is of importance to remember, however, that very strong currents are not admissible about the head and face. As a rule, I usually begin with three cells, gradually increasing their number to five or six. When the application is made to other parts of the body, as, for example, to the extremities, currents of much greater strength may be employed. In this connection it is worthy of note that currents of considerable quantity, such as those obtainable from large zinc and carbon cells, are preferable to all others. It is impossible to lay down infallible rules as to the length of time the current should be allowed to do its work, since much will depend upon the character of the skin—whether soft and permeable or the reverse. As a rule, from ten to twenty minutes will be found sufficient, though exceptionally the current may be allowed to exert its influence for a somewhat longer time.

When cataphoresis is resorted to for strictly medical purposes, as, for example, in the treatment of *local pain*, the effects of the anæsthetic may be re-enforced by supplementary injections of antipyrine, theine, or pyrogallic acid into the affected area.

Since the publication of my first paper on cataphoresis Dr. Frederick Peterson and others have done some clever work in the same field.

So much, then, for the various means at our disposal for introducing the anæsthetic into the integument and subjacent tissues.

We now come to the second part of the problem—the perpetuation of the effects of the anæsthetic upon the peripheral nerves. There are various ways of accomplishing this, according as to whether we desire to prolong the effect of the anæsthetic for operative or medical purposes.

It will be well to consider the surgical application of the principle first.

b. Methods of Perpetuating the Action of Cocaine upon the Peripheral Nerves.—The Prolongation of the Local Action of Cocaine for Surgical Purposes.

The Author's Method.—When cocaine is injected into one of the extremities it is an easy matter to perpetuate its action to any reasonable extent. It is, in fact, only necessary to arrest the arterial and venous circulation, as I long since demonstrated (*N. Y. Med. Jour.*, Sept. 19, 1885, and Jan. 2, 1886), by the aid of an appropriate ligature around the limb, or when this is impossible, as in the breast and back, by the application of rings, clamps, and the like. The latter are, however, much less perfect in their action than the ligature; and I shall therefore presently describe a procedure by which they can be got rid of altogether. Without anticipating, however, let it be assumed that an operation involving both time and skill is to be performed upon one of the extremities.

The plan to be followed in anæsthetizing the field of operation and perpetuating the effects of the anæsthetic, as originally described by me, is this:

Mapping out the Veins.—As the puncture of large veins, though not usually followed by serious consequences, is to be avoided when possible, the following precautionary measures may be adopted: A piece of ordinary elastic webbing is passed around the central portion of the limb and drawn sufficiently tight to

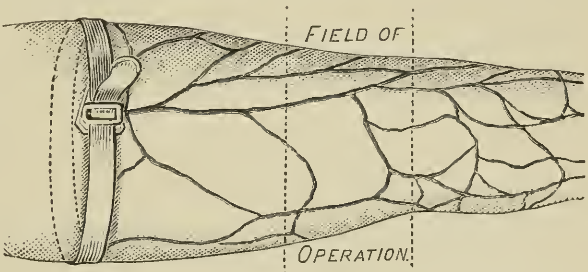


Fig. 1.

cause swelling of the superficial veins. It is now an easy matter to trace out the course of the distended vessels (Fig. 1) with an ordinary coloured pencil; so that, when the ligature is removed, these topographical reminders remain upon the integument.

The Exsanguination of the Limb.—To render the application of the tourniquet, subsequently employed in arresting the circulation, as comfortable as possible, it is well to exsanguinate the limb with an ordinary Esmarch bandage (Fig. 2). The latter should be carried up *to* (but not beyond) the field of operation, and maintained in place till the injections of the anæsthetic are completed. A strong flat tourniquet is then applied about the limb *above* the field of operation, and drawn sufficiently tight to interrupt the circulation in the vessels (Fig. 3). The bandage is then unwound from the lower part of the limb. Some operators, I believe, prefer to interrupt the circulation in the veins alone; but the result obtainable in this way is not quite so perfect. By this method complete anæsthesia has been maintained for scientific reasons for an hour and a half; such a prolongation of the anæsthesia will, however, scarcely be called for in practice.

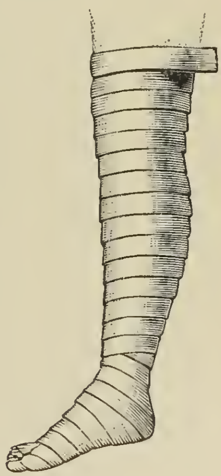


Fig. 2.

Operations of magnitude, such as extirpation of tumours, ligation of large vessels, and even

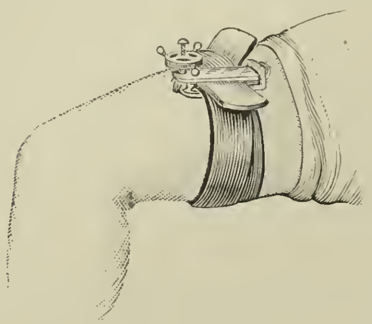


FIG. 3.

amputations of the extremities, have been performed successfully by the use of this method.

THERAPEUTIC THROMBOSIS, OR THE LOCALIZATION AND PROLONGATION OF THE ACTION OF COCAINE.

This procedure was first described by me in the *New York Medical Journal* for December 26, 1891.

It is self-evident that while it is possible to employ the method previously described in operations upon the extremities, this can not be done in the surgery of the back, abdomen, breast, or head. Then it is necessary to resort to other means of prolonging the effect of the anæsthetic. I have already alluded to one of these—the application of rings of various sizes, covered with India rubber, and pressed with bands upon the tissues surrounding the field of operation (Fig. 4). But while in this way it is possible to greatly lessen the circulation in the area inclosed by the ring, it is not possible to entirely suspend it: consequently a greater or less deportation of the anæsthetic by the blood stream is inevitable. To obviate this I have devised the following plan, which entirely relieves the operator of the necessity of employing mechanical devices.

Four principles are embodied in the procedure; these are:

1. Injection of the anæsthetic (cocaine) into the skin.

2. The subsequent introduction through the same hypodermic needle, and without its removal from the part, of a non irritant oil.

3. Precipitation of this oil, after its injection into the skin, by the aid of moderate cold, *but without freezing the tissues.*

4. Taking up the slack of the skin near the seat of injection, should the integument be very elastic.

The technique involved in the practical application of these principles may be thus described: Into that portion of the integument which is to be anæsthetized an aqueous solution of the hydrochloride of cocaine is injected. Then, without removing the hypodermic needle, a considerable quantity of the oil of theobroma, or cacao butter, as it is commonly called, is likewise injected into the area which is to be rendered insensible.

Finally, by the application of cold to the skin directly after the execution of these manœuvres, we cause the oil to solidify within the parenchyma, thus obstructing the circulation in the capillaries and causing more or less complete stasis.

To carry these manipulations into complete effect a double syringe (Fig. 5) is required, one barrel containing a 2- or 3-per-cent. solution of the hydrochloride of cocaine and the other the oil of theobroma, which is maintained in a fluid state by occasionally dipping the syringe into warm water of about 110° F. The capacity of the barrel containing the anæsthetic is 100 minims, while that destined to contain the oil will readily hold 400 or 500 minims.

Both these barrels are connected by means of a bifurcated tube with the same needle: so that by pressing first upon one piston rod and then upon the other, the two liquids may be injected through the same needle at the will of the operator.

It is absolutely necessary that both the aqueous solution of the anæsthetic and the oil should proceed along the same path, so that the occlusion of the capillaries shall occur immediately after anæsthetization of the sensory filaments in their immediate vicinity. Hence the necessity of employing a double syringe and an aqueous solution of the anæsthetic—a solution that does not combine or solidify with the oil of theobroma, but remains fluid, and therefore physiologically potent. about the filaments of the sensory nerves. It is evident that oleaginous solutions of the alkaloid (cocaine) are inapplicable, for the simple reason that they combine and then solidify with the oil of theobroma, and are thus rendered inoperative, as is shown by the immediate disappearance of the anæsthesia.

The precipitation (solidification) of the oil in the tissues may be accomplished by applying an ice bag to the skin, or spraying it with ether, rhigolene, or ethyl chloride. I prefer the ethyl chloride, which may now be had in tubes of 30 grammes—a most convenient method of using it as a spray. It is by no means necessary to spray the parts continuously, occasional refrigeration being all that is required to maintain the oil in a solid state within the tissues. To appreciate this point, it must be borne in mind that the melting point of the oil of theobroma is from 86° to 95° F., so that a reduction

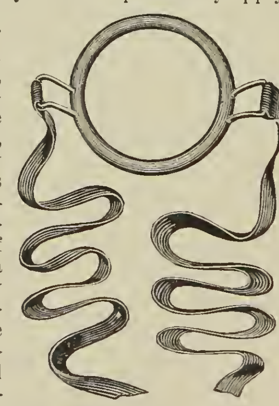


FIG. 4.

in temperature of from 15° to 20° is suffieient to keep the oil in a solid state within the parenchyma. Moreover, the oil of theobroma is specially applicable on account of its bland, non-irritating property, which admits of its injection in large quantities without the least chance of unpleasant consequences.

As a matter of course, having served its purpose, the oil is melted and deported by the general circulation when the application of cold to the skin is discontinued.

But even during the application of cold there is a gradual melting of the solidified oil, beginning at the periphery and proceeding toward the centre. In consequence of this the anæsthesia tends also to disappear at the periphery.

This subsidence of the anæsthesia may be enormously retarded by simply taking up the slack of the skin outside the zone of anæsthesia. To accomplish this it is only necessary to make a fold in the skin and maintain the latter by means of a strip or two of ordinary elastic adhesive plaster or by the application of a small spring clothespin, which may be had in the shops for a few cents. It must not, however, be inferred that stretching of the skin is requisite to the attainment of the most complete results; all that is required is the elimination of the *excessive elasticity* of the skin at the seat of injection. When this is done in the simple manner previously described the tissues above the solidified fatty mass—and nowhere else—retain a milky-white appearance as long as the oil is retained in a compact condition by the judicious application of cold. As soon, however, as the fatty mass is allowed to melt, or, in other words, when we neglect to spray the injected area with ether or ethyl chloride from time to time, the skin resumes its normal appearance and the anæsthesia is at an end. Here we have the absolute demonstration of the efficacy of the hardened oil to practically arrest the capillary circulation at the seat of injection.

By the application of these principles I have succeeded in maintaining a limited zone of anæsthesia for considerably over an hour, and I see no reason why the anæsthesia should not be maintained for a much longer period.

Recently, Krogius (*Ctrlbl. f. Chir.*, No. 11, 1894) has advocated the subcutaneous introduction of the anæsthetic in the vicinity of sensory nerve-trunks, in order to render insensible the areas to which they (the nerves) are distributed.

There is really nothing new in the principle here advocated, as it was proposed, and experimentally demonstrated by me ten years ago (*N. Y. Med. Jour.*, Sept. 19, 1885). Not only did I suggest at that time the introduction of the anæsthetic in the vicinity of definite sensory nerves, but I also applied the ligature, so as to arrest the circulation, and keep the cocaine solution in prolonged contact with the nerve.

In Experiment I, for example, to quote from my article above referred to, I injected 5 minims of a 4-per-cent. solution of the hydrochloride of cocaine in the neighbourhood of the external cutaneous nerve of the forearm, a short distance below and to the right of the biceps tendon. In a short time the effects of the agent became apparent. The skin for some distance around, and particularly *below* the puncture, was anæsthetic.

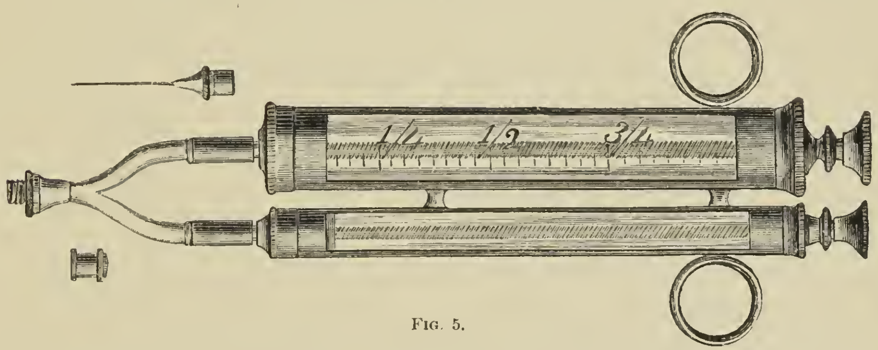


Fig. 5.

After the lapse of a few minutes, judging that the anæsthesia had reached its maximum extent and intensity, I applied an Esmarch tourniquet around the arm a short distance above the elbow. On examining the radial artery, I found that the pulse was entirely obliterated.

Fifteen minutes later the anæsthesia had extended down the right anterior aspect of the forearm several inches, and was of sufficient intensity to admit of pinching and pricking *ad libitum.*

After the lapse of nearly forty minutes I removed the tourniquet, not, however, because the anæsthesia showed the slightest diminution —for, on investigation, it proved to be as profound as ever—but on account of the tightness of the tourniquet, which caused the subject experimented upon considerable discomfort.

I fancy that this citation from my original paper will prove sufficiently convincing.

The Neurological Uses of Cocaine.

It is clear that a remedy possessed of the analgetic qualities of cocaine is capable of doing useful service in some departments of neurology. Accordingly, it is not astonishing that its assistance should be occasionally invoked in the management of certain conditions

characterized by *localized pain*, and notably in *circumscribed neuritis*.

Localization (Prolongation) of the Action of Cocaine in Circumscribed Neuritis.—Let us assume, for simplicity of presentation, that we have to deal with neuritis giving rise to pain in the temporal region; and that it has been decided, after general measures have failed, to attempt to abort the painful condition by local measures.

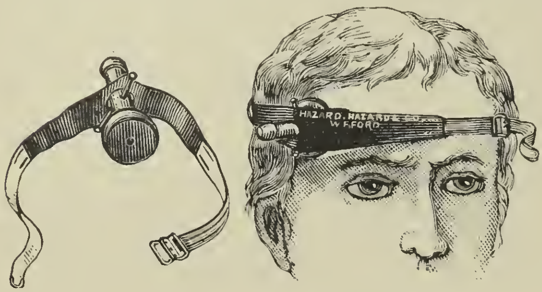


FIG. 6.

All that is required is to first introduce the anæsthetic, either alone or, better still, in combination with aconite, pyrogallic acid, or antipyrine; and then to place over the injected area a piece of fine-wire gauze, which in turn is pressed down upon the skin by a T-shaped block of wood, provided with an elastic strap (Fig. 6). The same thing may be accomplished by placing a lead weight upon the gauze while the patient remains in a recumbent position.

As a result of these simple expedients, the gauze is pressed well into the skin, so that the threads of the former cause occlusion of the subjacent capillaries, but without pressing out the anæsthetic, which remains caught, as it were, in the meshes.

By the use of this method, first described by me in the *Medical Record* for March 19, 1887, I have frequently produced a state of complete anæsthesia lasting more than an hour.

Local Medication of the Spinal Cord.—In the *New York Medical Journal* for October 31, 1885, and subsequently in the *Medical Record* for March 17, 1888, I showed that when a given amount of a medicament was injected into the vicinity of the spinal cord certain modifications in the functions of the latter might be induced.

Thus, when strychnine is injected in this manner, the functions of the cord, and notably the reflexes, are greatly exalted; much more so, in fact, than if the medicament had been simply injected into the general circulation, as in ordinary hypodermic medication. On the other hand, the modifications in function which I have observed after injection of an anæsthetic, such as cocaine, have been sensory in character—such, for example, as more or less complete anæsthesia, tingling, numbness, and various other paræsthesiæ, these phenomena being principally confined to the parts below the point of injection. The line of argument which led up to these results it is not necessary for me to detail; enough, that the experiments, which were at first conducted on dogs, were afterward verified in man; and the expedient has since been resorted to on several occasions. I was careful, too, to point out that this principle of medication offered an admirable and before unsuspected and potent means of treating certain derangements of the spinal cord. Thus it was shown that the painful phenomena present in spinal irritation might sometimes be abolished by resort to this exceedingly direct and effective therapeutic procedure; and to this I may add that the permanency of the effects produced is enhanced by the combination of cocaine with other remedies.

Having ascertained this much, it occurred to me that it would be a matter of practical interest to pursue these researches further; accordingly, shortly after the publication of the paper above referred to, I conducted a series of experiments which proved in the most conclusive manner that when cocaine was brought into the immediate vicinity of the posterior aspect of the spinal cord, its effects upon the latter were much greater than when even excessive doses were injected into the general circulation. For a detailed account of these experiments I must refer the reader to my original papers above quoted.

For the present I shall content myself with indicating the method which I have devised for depositing the solution of the anæsthetic in the immediate neighbourhood of the spinal cord, when, as in the painful crises of locomoter ataxia or spinal irritation, it may seem desirable to produce a local effect upon that organ. Having examined the vertebræ of the lower portion of the spinal column, I observed that the posterior surface of the transverse process, even at its greatest depression, though almost on a level with the posterior aspect of the spinal canal, did not fall at all, or, in rare cases, possibly very slightly, below it. This is especially true of the ninth, tenth, eleventh, and twelfth dorsal, and of the first and second lumbar vertebræ. As soon as I had observed this anatomical coincidence, I saw at once that, in so far as the lower vertebræ were concerned, the problem of approaching the immediate vicinity of the cord with the point of a hypodermic needle, without danger of wounding it, was solved. In a word, to make the matter short, the simple technique which I elaborated on the basis of these observations is as follows:

1. I first, as a rule, induce a condition of cutaneous anæsthesia in the vicinity of the spinous processes of the tenth and eleventh dorsal vertebræ over an area almost as large as a silver dollar. This I do simply for the comfort of the patient. The electro-chemical method elaborated by me, or the hypodermic syringe, may be employed for the purpose.

2. I now call into requisition a fine needle, about three inches long, provided with a handle and a sliding nut. The latter may be

fixed at any portion of the continuity of the needle by means of the screw. This needle I thrust down (about half an inch laterally from the spinous process of the tenth dorsal vertebra) until the bone is reached. The nut is then pushed down until it rests lightly upon the skin, and is secured in place by means of the screw (Fig. 7). I then withdraw the needle.

It is now clear, from what has already been said, that the distance from the nut to the point of the needle corresponds almost exactly with the distance from the surface of the integument to the cord. To make assurance doubly sure, however, I am in the habit of subtracting 2 or 3 millimetres from the measurement thus obtained.

3. Upon a fine cannula (Fig. 8), also provided with a sliding nut, the distance previously noted upon the needle is measured off (minus 2 or 3 millimetres), and the nut secured firmly in place.

4. This hollow needle is then attached to a syringe of 100 minims' capacity, filled with a 1·5-per-cent. solution of the hydrochloride of cocaine, to which is added about $\frac{1}{10}$ of a grain of pyrogallic acid. I have used solutions of various strengths, but am inclined to give preference to those of 1·5 per cent.

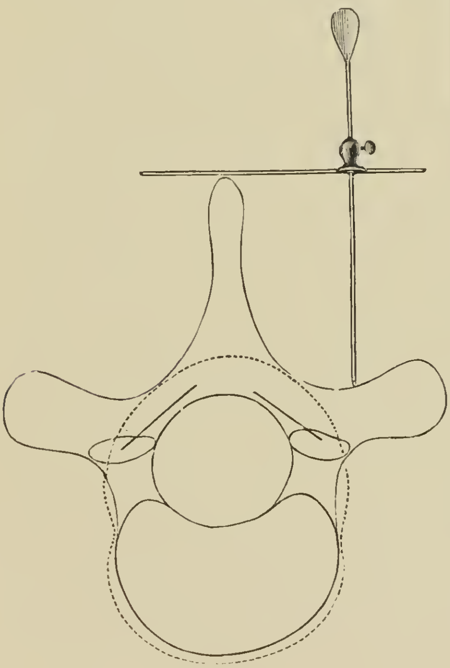


Fig. 7.

5. The cannula is now thrust into the tissue between the spinous processes of the tenth and eleventh dorsal vertebræ (I have sometimes inserted it between the ninth and tenth) until the nut, previously firmly fixed as described, rests upon the integument. The contents of the syringe are now slowly forced out, and the needle is withdrawn.

6. The patient should now be allowed to lie on his abdomen, with his legs hanging over the edge of the sofa or bed in such wise as to put the dorsal muscles on the stretch. This manœuvre presses the fluid in the direction of the least resistance—*i. e.*, toward the cord—besides causing the rigid muscles to act in a certain sense as an incarcerating mechanism; that is to say, in their rigid condition they prevent the medicament, to some extent, from being absorbed by the tissues outside of the spinal canal. Of course, when the solution has once entered the spinal canal, we can do nothing to keep it in permanent contact with the latter. The circulation of the lower segments of the cord is, however, as is well known, extremely lethargic, so that the solution can not be washed away very rapidly. This torpid state of the circulation, alluded to by Brown-Séquard in his papers on paraplegia, no doubt accounts for the persistence of numbness and anæsthesia more or less profound long after the injections have been made.

Fig. 8.

So much, then, for the technique of this mode of treatment. Relatively long as the description is necessarily, the execution of the manipulations themselves is by no means so difficult as might be imagined. I have employed the procedure many times, sometimes using cocaine alone, and sometimes combining with it the tincture of aconite or pyrogallic acid, according to the effects which it is desired to obtain.

In the affection commonly known as *spinal irritation*, whether there is a condition of congestion or one of anæmia I care not, its effects are certainly in the highest degree beneficial, as I have already had occasion to demonstrate to my entire satisfaction in several cases. How much good may be effected in inflammatory affections of the cord only an extended experience can, of course, determine. In purely functional derangements, however, its efficacy is beyond question.

In the *Medical Record* for March 17, 1888, I published a number of cases illustrative of the efficacy of this procedure in various functional affections of the cord.

The Irrigation of the Cauda Equina with Cocaine Solutions.—While engaged in testing the method of medicating the spinal cord just described I became impressed with the desirability of introducing remedies directly into the spinal canal, with a view to producing still more powerful impressions upon the cord, and more especially upon its lower segment.

It is a familiar fact of anatomy that the cord proper extends only to the first, or at most to the second, lumbar vertebra. The nervi lumbales, sacrales, and coccygei are therefore obliged to traverse a long distance within the spinal canal in order to attain their respective points of exit. It is thus that the

parallel nerve-stems are formed at the lower end of the cord. These fasciculi, in their totality, constitute the so-called cauda equina. Now let us recall two well-known facts of anatomy: the first of these is that the pia mater, properly speaking, comes to an abrupt conclusion at the end of the cord proper (the conus terminalis), while the second is that the blind sac of the dura mater extends to the end of the sacral canal. With these data before us we shall readily understand that when a needle is thrust down between the spinous processes of the third and fourth lumbar vertebræ, for example, close to the ligamentum interspinosum, the point of such a needle, after penetrating the dura mater, will find itself directly in contact with the filaments of the cauda equina, which from this point downward occupies the space of the spinal canal.

If such a needle is hollow and attached to a hypodermic syringe charged with cocaine, it is, moreover, evident that the solution may be readily deposited upon the filaments of the cauda. Again, there can be no doubt, especially if the injection is made between the second and third lumbar vertebræ, that the functions of the lower segments of the cord itself may be powerfully affected in this manner. In a word, we have to do with a local saturation of the cerebro-spinal fluid with the anæsthetic, a condition which must inevitably make itself felt upon the cord.

To deposit the solution of the anæsthetic within the vertebral canal I proceed as follows: A small trocar, half an inch long and of the diameter of a wax match, is first thrust through the skin between the second and third lumbar vertebræ. A long, fine, hollow needle, screwed to an ordinary hypodermic syringe, is then forced *through the opening in the trocar* (Fig. 9),

FIG. 9.

and down through the soft tissues adjoining the ligamentum interspinosum till the spinal canal is entered. The entire contents of the syringe may then be emptied upon the fibres of the cauda equina.

The effects produced in this way are various paræsthesiæ—tingling and numbness—and even anæsthesia more or less profound upon the lower limbs and the scrotum. These phenomena are sometimes very persistent, lasting an hour or even longer.

As a rule, the paræsthesia and anæsthesia are more irregularly distributed than when the posterior columns of the cord are anæsthetized in the manner first described.

A more elaborate description of this method, with the histories of some cases in which it has been tried, may be found in my monograph on *Pain* (*Philadelphia*, 1894).

The Localization of the Action of Cocaine upon the Brain.—There is one organ which is exceptionally well placed with respect to the possibility of concentrating the action of remedies upon it; I refer to the brain, and more especially the cortical areas of the cerebrum. To appreciate how true this is, it is necessary to place in juxtaposition the following facts:

1. That the main blood-supply of the cortex is contingent, or largely contingent, upon the unobstructed flow through the carotid and jugular vessels. Hence when the blood flow in one or both of these sets of vessels is arrested, or even partially arrested, as by compression, cortical function is directly interfered with, as is shown by the confusion of ideas, stupor, and even unconsciousness engendered.

2. It has long been known—and the fact has frequently been commented upon in medical literature—that chemicals applied, especially in a fluid state, to the lining membrane of the nasal cavity are speedily absorbed, producing in this way characteristic physiological effects. Thus calomel has been blown into the nose, and in a short time has produced severe salivation.* Narcotic substances, and more especially morphine and cocaine, have also been spread upon the mucous membrane of the nasal cavity, and in a short time given rise to characteristic phenomena. I am told that the effects thus induced upon the central nervous system, and more especially the brain, by the use of the last-named drug are familiar to rhinologists.

The most reasonable and generally accepted explanation of the prompt action of narcotic substances when used in this way is that which assumes that the absorption of the remedy—or at least the greater part of it—takes place by the way of the vessels which penetrate the lamina cribrosa. If we admit the plausibility of this hypothesis, we shall then perceive that remedies administered by way of the mucous membrane of the nose must reach the brain, and especially the cortex cerebri, in a more concentrated state than when administered at a distance, either hypodermically, by the rectum, or by the stomach. Even though the amount of medicinal substance absorbed may not be great, its increased concentration at the seat of its action (the brain) must of necessity result in physiological effects out of proportion to the quantity of chemical involved.

Here we have an explanation, and I think a true one, of the remarkable cerebral symptoms often produced by exceedingly small quantities of medicinal substances when applied in solution to the conjunctiva.

3. It is a fact that, if narcotic fluids are introduced into the nasal cavity in the manner previously set forth, and if shortly thereafter the flow of blood in the jugular veins is considerably retarded by the application of pressure at a suitable point in the neck, the effects of the remedies thus administered may be appreciably enhanced and prolonged. This accords with all that I have been able to ascertain respecting the behaviour of remedies when brought in contact with the peripheral nerves by hypodermic injection, and maintained there by occlusion of the capillaries, or by constric-

* Rainbert. De l'administration des médicaments par l'intermédiaire de la muqueuse des fosses nasales. *Jour. de méd., de chir. et de pharm.*, Bruxelles, 1867, p. 17.

tion of the artery, veins, or both, above the point of injection (next the heart).

These preliminary observations will, I trust, make the principles involved abundantly clear. Let me pass, then, at once to the description of the simple procedure which I have found most serviceable in giving practical effect to the principles above enunciated. The first step of importance is the introduction of the remedy by way of the nose. To do this most effectually, the mucous membrane should first be cleansed with warm water, which serves at the same time to expand the capillaries. The medicament (morphine, cocaine, atropine, or the like) may then be introduced in solution through the nostrils by the aid of an ordinary medicine dropper or an atomizer. This simple manipulation is best accomplished while the patient reclines upon his back.

After the lapse of ten or fifteen minutes the second step may be proceeded with. This consists in materially restricting the lumen of the internal jugular veins by the application of pressure.

After numerous trials, I have found that the jugulars are best compressed by the application of small dry cups over the course of the vessels, one at each side of the neck on a level with—or a little below the level—of the thyreoid cartilage.

The cups, which are joined together in front by an adjustable steel band, are about 2 inches long and ½ an inch wide. They are made of metal—silver or steel—and are held in place by an elastic strap which passes around the neck and is secured in place behind by the aid of a simple buckle (Fig. 10). The open side of the cup is, moreover, somewhat concave in an antero-posterior direction, which admits of elevating the veins and surrounding tissue more effectually. In this way it is possible to draw the vessels into the cups, partially at least, thus causing the edges of the latter to act energetically upon the lumen of the veins. The little dry cups being maintained in position over the vessels by the aid of this simple band, the air contained in them is rapidly exhausted by means of an air-pump and vacuum chamber, which exert their influence upon the interior of the cups through the intermediation of small, non-collapsable India-rubber tubes.

It is self-evident that the cohesion of the compressing apparatus thus obtained, as well as the elevation of the tissue within them, renders valuable assistance by preventing the slightest displacement of the subjacent vessels. In a word, the veins, instead of being compressed in a backward direction, are, as previously pointed out, drawn toward and compressed by the edges of the cups. When all is properly adjusted, the elastic bands previously described may be tightened at will. This last step is usually, however, unnecessary, the atmospheric pressure being adequate.

When slight vertigo has been induced in this way, the evidence is conclusive that the stasis of the intracranial venous circulation is sufficient for therapeutical purposes.

There is no special limit to the length of time during which compression may be continued; but from what I have been able to determine, I should fancy from twenty minutes to half or three quarters of an hour to be sufficient.

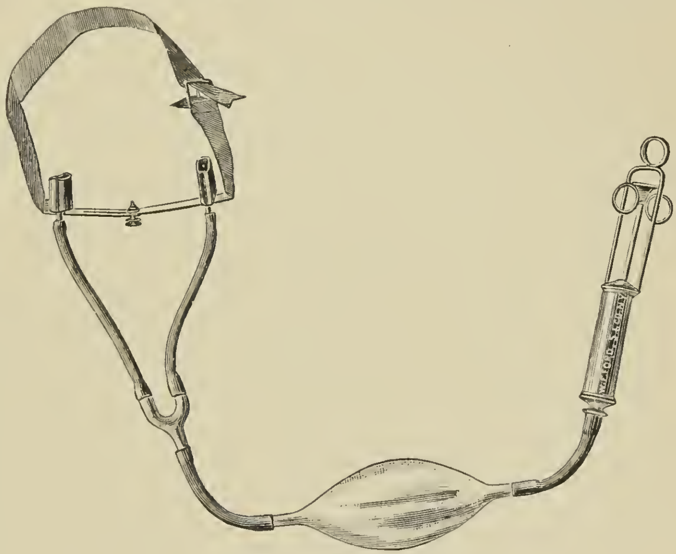


Fig. 10.

In my original article on the localization of the action of remedies (cocaine, morphine, atropine, etc.) upon the brain (*Med. Record*, Dec. 31, 1892) I recorded the histories of a number of cases illustrative of the efficacy of the procedure. Certain forms of *frontal headache*, *simple depression*, and *mental hebetude* are readily relieved by it. The characteristic exhilaration produced by the drug is more easily evoked when it is given by the nose in this way than when it is administered hypodermically or by the mouth.

Obviously the plan of treatment just described has distinct advantages, for when the nasal mucous membrane is sufficiently healthy to absorb the medicament, the stomach, if delicate, may be spared the reception of the chemical products which might add to the local derangement. Powerful alkaloids are those best adapted to this form of administration, as they may be given in small doses, and are, therefore, readily taken up by the nasal mucous membrane, of which the power of ab-

sorption is limited. Again, there is little or no danger of setting up a pernicious habit, as is the case in hypodermic medication. Then, too, the prompt relief of intractable symptoms in a relatively short time, and without inordinate drugging, is a notable advantage. Finally, I would add that where the nasal mucous membrane is not sufficiently healthy to absorb the medicated fluid in sufficient quantity it may be injected into or beneath the intranasal mucous membrane by the aid of a long hypodermic needle attached to the syringe conventionally employed. This I have done on one occasion only.

The Action of Cocaine on the General System.

The physiological action of cocaine differs somewhat from that of coca, so that the inference is inevitable that the alkaloid does not completely correspond to the leaf.

Given in moderate doses (from $\frac{1}{4}$ to $\frac{1}{2}$ a grain), cocaine acts as a stimulant to the heart's action, while at the same time its most characteristic effect—mental exhilaration—is also apt to appear, especially if the hypodermic method of exhibition has been employed.

Where, however, it is given in excessive amounts (from 5 to 10 grains) the phenomena induced are of a distinctly threatening character. Among the more striking manifestations are abnormal exaltation of the feelings, loquacity accompanied by mental incoherence, severe sweating, fall of temperature, shallow, irregular respiration, dilatation of the pupils, disturbance of vision, nausea, feeble pulse, and ultimately collapse.

While the production of these graver occurrences demands, as I have said, in the majority of cases, relatively larger doses, the rule is by no means invariable, for again and again it has happened that small amounts of the alkaloid have given rise to the most threatening symptoms.

Especially when the drug is used about the head should care be exercised in its administration, for here it is apt to reach the nerve-centres in a state of relative concentration, and give rise to symptoms out of all proportion to the quantity administered.

It is best, therefore, to employ solutions of low percentage when it is possible; and, when this can not be done, it is well to take some simple precautions of a general character.

Among the best of these is the preliminary hypodermic administration of from $\frac{1}{8}$ to $\frac{1}{4}$ of a grain of morphine, according to the age of the patient. The physiological antagonism between the drugs is pronounced, so that while morphine is not an absolute antidote it is at least most valuable in counteracting the toxicity of cocaine.

When toxic symptoms have declared themselves, sal volatile may be given internally, a precaution which may well be preceded by the inhalation of 2 or 3 drops of the nitrite of amyl.

Cocaine has been given internally in doses of from $\frac{1}{6}$ to 1 grain in *melancholia, hysteria,* and *neurasthenia.* It is, however, of no use whatever in hysteria, and indeed its uninterrupted employment for any length of time is to be avoided, as inveterate addiction is easily established.

The great advantage of the system of local administration which I have devised consists in this: that by its use not only may the anæsthesia be prolonged to a practically indefinite degree, but the anæsthetic itself can be given in the form of solutions of low percentage. I myself have made use of solutions as low as $\frac{1}{10}$ per cent., and have long since given an account of my work in this field in my monograph on *Local Anæsthesia* (New York, 1886).

[The fluid extract of coca, *extractum cocæ fluidum* (U. S. Ph.), and the liquid extract, *extractum cocæ liquidum* (Br. Ph.), are practically the same preparation. The dose is from $\frac{1}{2}$ to 2 teaspoonfuls. The hydrochloride, *cocainæ hydrochloras* (U. S. Ph., Br. Ph.), *cocainum hydrochloricum* (Ger. Ph.), is the only official cocaine salt. Gelatin discs, *lamellæ cocainæ* (Br. Ph.), each weighing about $\frac{1}{50}$ of a grain and containing $\frac{1}{200}$ of a grain of the hydrochloride, are convenient for use in the eye. *Cocaine phenate,* or *carbolate, phenol-cocaine,* a yellowish viscid mass, has been much used in dental surgery.]—J. Leonard Corning.

COCCUS (U. S. Ph., Br. Ph.), **COCHINEAL.**—The dried females of *Coccus cacti,* an insect found in large numbers upon various species of cacti in many tropical and subtropical countries, especially those of the Western hemisphere. Anodyne, antispasmodic, stimulant, and diuretic properties have been ascribed to it, but the only disease in which there is any evidence that it is of value is *whooping-cough,* in which $\frac{1}{2}$-grain doses three times a day have been used with some benefit. Its principal use in medicine is for colouring various mixtures, of which the most important are the compound tinctures of cardamom and of cinchona, and for the preparation of a test solution official in the U. S. Ph., which contains 1 part of cochineal, 20 parts of water and 60 parts of alcohol. It turns violet in the presence of alkalies and yellow-red in the presence of acids. The tincture, *tinctura cocci* (Br. Ph.), may be given in doses of from 20 to 30 drops. Somewhat similar to cochineal is alkermes, chermes, or kermes, which consists of the females of *Coccus ilicis,* an insect found in the countries bordering on the Mediterranean.

Russell H. Nevins.

COCHLEARIA, *herba cochleariæ* (Ger. Ph.), scurvy-grass, the herb of *Cochlearia officinalis,* is employed as a remedy for *scurvy* and has been recommended in *chronic rheumatism.* The dose of the expressed juice is from 20 to 40 drops, three times a day.

COCILLAÑA BARK is the bark of a large tree, a *Guarea* of undetermined species belonging to the order *Meliaceæ* and growing in Bolivia. It is said to be employed there as an emetic and cathartic. The drug is not official and is of but comparatively recent introduction into this country. The composition of the bark is not settled as yet, though Rusby, who introduced it, thinks its activity dependent upon the presence of an alkaloid.

This is disputed by Eckfeldt, who believes its active principle to be a glucoside.

The physiological action of the bark has, as yet, been but incompletely studied. In small doses cocillaña acts as a gastric tonic and as a depressing expectorant similar in character to ipecac, though rather more stimulating. In larger doses (20 to 50 grains) it causes vomiting, diarrhœa, sweating, and prostration, results which occasionally follow the use of doses even smaller. Violent sneezing, frontal headache, and the discharge of nasal mucus are also said to result from doses of considerable size.

The drug is thought by Stewart to be of much value in *bronchitis*, especially the more chronic forms. Indeed, he is inclined to rate it as more valuable in many cases than ipecac. In these conditions it acts to diminish cough and to loosen the bronchial mucus, the amount of expectoration at the same time being diminished. Others have thought cocillaña beneficial in *acute* and *subacute bronchitis*, *bronchopneumonia*, and *phthisis*.

Two non-official preparations of cocillaña are made, a fluid extract (*extractum cocillanæ fluidum*), of which the dose is from 10 to 20 minims, and a 25-per-cent. tincture (*tinctura cocillanæ*), of which the dose is from ½ to 2 fl. drachms. A syrup also is occasionally employed, but the fluid extract is to be preferred.

HENRY A. GRIFFIN.

COCOA.—Cacao, or, as it is more commonly called, cocoa, is obtained from the seeds of *Theobroma Cacao*. The cacao tree is a native of Brazil and tropical America. The finest grades are now obtained from Mexico and the northern portions of South America, and are derived from cultivated plants. The fruit is pear-shaped and about 6 inches in length. It has a thick, warty rind and a soft, sweet pulp which contains numerous seeds. These seeds are from ¾ to 1¼ inch long, are oblong in shape, and are covered by a brittle testa, or envelope, which is easily separated from the kernel. These envelopes are the cocoa shells found in the groceries. The kernel is reddish-brown in colour and of a bitterish, aromatic, and oily taste. When properly cured, it loses the bitter taste. The aromatic flavour is developed by roasting. The chemical composition of the cocoa seed is extremely variable. The following analysis is that of Koenig: Proteids, 14·76; fat, 49·00; starch, 13·31; other non-nitrogenous matters, 12·35; woody fibre, 3·68; ash, 3·65; water, 3·25.

The following products are obtained from the cocoa seed: cacao-butter, cocoa, chocolate, and an aromatic alkaloid known as theobromine. Theobromine, when isolated, occurs as a colourless or white crystalline powder, sparingly soluble in cold water and having a bitter taste. In its physiological qualities it is similar to caffeine, but is much weaker. It contains more nitrogen than caffeine does, and occurs in such small quantities in the ordinary preparations of cocoa and chocolate as to have little physiological effect. It is not used as a medicinal agent.

As ordinarily prepared, the seeds are slightly roasted and ground into a powder, from which a part of the fat is usually removed before it is sent to the market. This powder still contains from 20 to 30 per cent. of fat. Cocoa *nibs* are the cocoa beans which have been freed from the shell and broken into fine pieces. It is the purest preparation of cocoa which can commonly be purchased. An infusion of these nibs is the simplest cocoa beverage. Chocolate consists of the kernels of the seeds which have been ground and combined with sugar in a paste and pressed into moulds. The amount of sugar is sometimes equal to that of the cocoa. It is usually flavoured, vanilla and cinnamon being chiefly used. The chocolate used in different countries differs chiefly in the character and amount of flavouring used. As a rule, cocoa differs from chocolate in the smaller amount of fat and sugar it contains. Chocolate is therefore more valuable as a food, but is not so readily borne by some stomachs as the preparations known as cocoa. The various trade preparations, however, differ greatly in their composition. They are not named in strict conformity either to their mode of preparation or to their chemical composition. Simple cocoa is usually better than the various prepared "soluble" and "digestible" cocoas, though each is much lauded by its maker as having properties of peculiar value. The following analysis is given by Koenig as the average result of a number of chemical examinations made of the best-known kinds of chocolate: Proteids, 5·06; fat, 15·25; sugar, 63·81; other non-nitrogenous matters, 11·03; woody fibre, 1·15; salts, 2·50; water, 1·55. It contains, therefore, a large amount of non-nitrogenous material. Owing to the great quantities of sugar, starch, and fat which enter into its composition, together with a moderate amount of proteid, it forms a true food. In this it differs from other beverages. It is a valuable food element in conditions characterized by wasting. In such conditions, unless it disagrees, it may properly form a part of the dietary. So-called cocoa, though less nutritious than chocolate, may sometimes be employed when the richer preparation can not be taken. It is alleged that the method of preparation sometimes affects the digestibility of cocoa injuriously. A drink made from cocoa shells contains very little nutritious matter. It is practically little more than flavoured water.

Chocolate and cocoa, like most complex manufactured articles, are frequently adulterated. Many substances used for this purpose—such as flour, starch, and arrowroot—are not themselves injurious. The cacao-butter is sometimes removed and cheaper oils and fats are substituted for it. The deleterious substances most commonly used for adulteration are alkalies and various chemicals. An excessive amount of fibre, due to the admixture of an undue proportion of the shells, is sometimes found. Good chocolate is smooth, firm, and shiny externally. When liquefied and cooled, it should be oily on the surface and not viscid.

Several vegetable products, bearing similar names, are often mistaken for cocoa; coca, the alkaloid of which is cocaine, and the cocoanut have no relationship to each other or to cocoa.—FLOYD M. CRANDALL.

CODEINE, *codeina* (U. S. Ph., Br. Ph.), $C_{18}H_{21}NO_3 + H_2O$, is an alkaloid obtained from opium. According to the Br. Ph., it is obtained by separation "from the ammoniacal liquors from which morphine has been obtained, by evaporating, treating the residue with water, precipitating with caustic potash, and purifying the precipitated alkaloid by recrystallization from ether." It appears as white or nearly translucent crystals, without odour, but of a faintly bitter taste, and slightly efflorescent in warm air. It is soluble at 59° F. in 80 parts of water and in 3 parts of alcohol.

The physiological action of codeine is very similar to that of morphine, though much feebler, Bartholow regarding 4 grains of codeine as the equivalent of 1 grain of morphine. Besides this quantitative difference, there exists also some slight difference in the quality of action, for codeine, though more calming and soothing than morphine, is of far less anodyne and narcotizing power. Codeine, moreover, does not appear to lessen the bronchial and the digestive secretions as morphine does, and digestive disturbances and constipation are less frequent from its use. Though codeine is relatively feeble in action and doses of 5 grains have been productive of little effect, on the other hand doses much smaller have produced alarming results, and in one case 4 grains appear to have caused great danger, the symptoms noted having been circulatory excitement and exhilaration and then depression, anxiety, restlessness, delirium, prostration, and almost collapse.

The greatest diversity of opinion exists among authors as to the appropriate dose of codeine. Though circumstances, and especially habit, will permit of its administration in considerable amounts, there can be no doubt that the doses recommended by some writers are recklessly and dangerously large. That such disparity of opinion should exist is undoubtedly due to the differences in strength and purity of the preparations which have been employed, for it seems certain that commercial codeine is often contaminated by some of the other opium alkaloids, and especially by morphine. While pure codeine, then, would appear to be relatively feeble in effects and its appropriate dose therefore large, the great variation in the purity of its commercial preparations must not be forgotten, and the initial dose should always be small.

As a quieting and calming agent in *nervous and irritable conditions* codeine is most excellent, and, though the use of the drug in such cases should be as brief as possible, as should be the use of all sedatives, yet it is not open to the objections against morphine so used, for it rarely disturbs digestion, and the formation of a habit from its employment is exceedingly unlikely. For such conditions the dose is $\frac{1}{4}$ a grain, given, if necessary, several times daily. As a hypnotic it is very useful, especially in *nervous insomnia.* For this purpose $\frac{1}{2}$ a grain may be given and repeated at intervals of an hour, if necessary, until several doses have been taken. In insomnia due to pain codeine is also effective, but certainly not so energetic as morphine. *Abdominal distress* and *colic* are often favourably affected by codeine. It has been given for this purpose to infants six months old in doses of $\frac{1}{24}$ of a grain, but its use for the very young has caused alarming symptoms and is therefore not to be recommended. In no condition is codeine surer to be effective and valuable than in *nervous* and *irritable cough*, whether this is due to pure nervous influences or is a harassing and exhausting accompaniment of phthisis and similar pulmonary diseases. For such a condition the drug is in the highest degree valuable, and the relief afforded by it is usually prompt and considerable. For this purpose the dose is $\frac{1}{4}$ of a grain, repeated at intervals of three and even two hours, if necessary. A combination of codeine with diluted hydrocyanic acid is especially valuable for the harassing and exhausting cough of phthisis, for which, in doses of a fl. drachm, the following mixture is much employed:

℞ Codeine....................	$\frac{1}{4}$ grain;
Diluted hydrocyanic acid ...	3 minims;
Ammonium chloride.........	3 grains;
Syrup of wild cherry, enough to make..................	1 fl. drachm.

[Codeine has been used with success in some severe cases of *whooping-cough.*]

That codeine is of great value in *saccharine diabetes* is beyond all doubt, many cases showing great diminution of the amount of urine together with lessening or disappearance of the glucose it contains, while some few cases are apparently permanently cured. Its remedial action in the disease is not invariable, however, and some cases, especially the severer ones, are entirely unaffected by it. The comparative excellence of morphine and codeine in diabetes has been the subject of much discussion and variance of opinion, but the harmonizing of these conflicting opinions lies not in the disease but in the particular case, for in some cases codeine is undoubtedly superior, in others morphine, in others opium, while in many they are all of lesser value than other drugs. In one particular morphine is more advantageous in diabetes than codeine, and that is in its relative cheapness, for the cost of codeine is such that its use in the large quantities often necessary in this disease is in many cases impossible. In giving codeine to diabetics the initial dose should be 1 grain, and this may rapidly be increased according to the symptoms and requirements, for the disease undoubtedly affords tolerance to the drug, and habit makes large doses well borne. In the cure of the *morphine habit* codeine is at times very desirable when a temporary substitute is necessary for the diminished or withdrawn morphine, and its powers to quiet, together with the slight danger of a habit from its use, make this application of codeine at times exceedingly valuable.

In some cases where an idiosyncrasy to morphine exists codeine will be tolerated, though this is not invariably the case.

Several salts of codeine have been used, and of these the phosphate, *codeinum phosphoricum* (Ger. Ph.), is an excellent preparation, but the one generally employed is the sulphate. This salt, indeed, is often used in preference to the alkaloid itself, and has the advantage over it of greater solubility.

Codeine may conveniently be administered in tablets or in pills, but if a fluid form is preferred a syrupy vehicle offers some advantages, and syrup of wild cherry seems particularly eligible. Codeine is also sometimes given by hypodermic injection, and for this purpose it has been recommended to dissolve the sulphate of codeine in hot water, on account of its relative insolubility in cold water, and then to inject while it is hot and before recrystallization has time to take place.—Henry A. Griffin.

COD-LIVER OIL, *oleum morrhuæ* (U. S. Ph., Br. Ph.), *oleum jecoris aselli* (Ger. Ph.), is the oil obtained from the livers of the common cod. Several varieties are found, varying in colour, odour, and taste, the variation depending upon the different methods of preparation. The most desirable and purest kind is of a light-yellow colour, of a faintly acid reaction, and almost without odour. Chemically, there is little difference in the different varieties, but the lighter the colour the easier of digestion is the oil and the better suited for internal use. For inunctions and other external applications the darker oils are entirely satisfactory, save for their stronger odour, and they are much cheaper. Various substitutes in the shape of other animal and vegetable fats have been proposed, but none of them are so effectual as this oil. For this there are two good reasons, the one being its greater digestibility from its containing the constituents of bile, and the other the presence of iodine, bromine, phosphorus, iron, and certain salts which are usually of benefit in cases where it is indicated. It is also much more diffusible through animal membranes, a fact which renders it easier of absorption. The oils obtained from the livers of the common skate and of the halicore, or dugong, have been tried as substitutes, but no great degree of success has been obtained from their employment, and their use is confined to the countries in whose waters they are found. For inunction purposes, where a nutritive effect is desired, the great diffusibility of cod-liver oil renders its use especially appropriate.

There is a large number of proprietary preparations in which are combined a variety of substances designed to disguise its unpleasant odour and taste. A few of these, put up by reliable houses, are not objectionable, but in the majority of cases their use is not advisable, as the vehicle allows of the substitution of inferior grades of oil or of fatty bodies of an entirely different nature. The emulsions with lime are the best of this class of preparations. The addition of iron, lime, hypophosphites, etc., is often convenient, but hardly desirable as it precludes varying the amount of oil given without a corresponding change in the quantity of the adjuvant. Consequently it is better to administer them at the same time with the oil rather than combined with it. The disguising of the taste and odour is not a matter of any great difficulty, provided the proper amount of care is taken. In all cases, no matter whether the oil is objectionable or not, 15 minims of sulphuric ether should be added to each ounce, as it renders it easier to take and more readily digested, and where there is great disgust at first, enables larger initial doses to be taken. The commonest and simplest method of overcoming the odour and taste is to moisten the spoon with some strong-smelling or strong-tasting substance, pouring a few drops of the same upon the surface of the oil, and swallowing it rapidly. Spirit of camphor, raw spirit, and the essential oils are the bodies most commonly used, and whichever seems most agreeable in any particular case may be employed. The only caution to be observed is the avoidance of too large a quantity, as, being volatile, any one of these is apt to increase the liability to eructations. It is well in some cases to rinse out the mouth with one or another of them to blunt the sense of taste somewhat and to prevent the contact of the oil with the mucous membrane. Floating the oil on the juice of a lemon or orange and mixing it with the froth of ale, beer, porter, or soda water are acceptable methods in some cases. The addition of 1 per cent. each of the oil of eucalyptus and brandy or compound spirit of lavender is said to disguise the taste entirely. Although, as a rule, it is not desirable to combine offensive bodies with articles which are used as food, an emulsion made with the yolk of a raw egg forms an unobjectionable combination, so far as taste and odour are concerned, and where there is a necessity for a highly concentrated food it would prove desirable. Pavesi's method of deodorizing cod-liver oil is said to render it free from offensiveness. It is carried out as follows: To 1,000 parts of the oil are added 50 of ground coffee and 25 of animal charcoal, and the entire mixture is heated for an hour in a flask over a water-bath, and after standing for three days, being frequently shaken up, is filtered. An emulsion made by shaking together equal parts of the oil and any good preparation of maltine is not bad to take, and under some circumstances it is a desirable preparation. A morsel of smoked herring, taken immediately after the oil, will in general remove any unpleasant after-taste which may remain. Children, as a rule, take the oil without any difficulty, apparently not noticing its unpleasant features, but occasionally the appetite is affected and the condition for which it is intended as a remedy appears aggravated, but tolerance is usually established at the end of a few days and the beneficial effects of the oil are manifest. Sometimes all methods seem to fail with children, and in such cases the oil may enter into the composition of bread or cake which they can easily be induced to take. With the use of the best grade of the oil, attention to little details, and the careful avoid-

ance of exciting undue disgust, it is extremely rare to find an individual who cannot be habituated to its use, but persons are occasionally met with who are entirely unable to assimilate the oil, even if they have no difficulty in taking it. No exact limit to the quantity to be given can be laid down, as the assimilative powers of various individuals differ so greatly, and any excess over what is properly digested is harmful, giving rise to diarrhœa and a general disturbance of the digestion. The maximum amount which an average adult can take with advantage is 3 tablespoonfuls daily. It is best to begin with teaspoonful doses or even smaller quantities, gradually increasing them until the desired amount has been reached. As this oil is rarely indicated in cases where there is very great urgency, it is best to increase the size of the doses very gradually, indeed almost imperceptibly. From time to time, daily at first, the stools should be examined to ascertain if free oil is present, and when this occurs the dose must be diminished. As a rule, during the first fortnight a small amount of oil will be found, but this gradually disappears as the digestive and absorptive functions improve. It is of importance that the oil should be taken after eating, as then the quantity of bile in the intestines is much larger than at any other time, and its aid is necessary for the proper digestion of the oil. No fluids should be taken for an hour or so afterward, as they increase the tendency to the oily eructations which in some cases constitute the principal objection to the use of the oil. The only contra-indications to its use are: A total inability to digest it, diarrhœa, acute febrile disorders, a condition of plethora, a fatty habit of the body, and states in which there is a deficiency in the amount of bile in the intestines.

There are no conditions in which this oil is so useful as in most forms of *phthisis*, especially the chronic. Persons with caseous pneumonia, acute pulmonary phthisis, particularly if there is considerable elevation of the temperature, are, as a rule, not benefited by its use. In suitable cases the wasting ceases, the expectoration and night sweats lessen, and the entire general condition improves. Although regarded as a specific by many, the oil does not act as one, but restores and maintains the elements which are so rapidly consumed in these disorders and can not be obtained from the ordinary articles of food. To exert its maximum good effects, it must be supplemented by the proper hygienic and climatic measures. All that properly can be alleged for it is that it improves the general nutrition and gives time for and assistance to the other treatment appropriate in such cases.

In nearly all the conditions included under the vague term of *scrofula* it may be regarded as the mainstay in the treatment. It is more especially valuable in *caries*, *necrosis*, and *articular troubles*, but in *strumous enlargement of the glands* it is only fairly useful, except after the formation of ulcers or abscesses due to the disintegration of the glands (cf. Hypophosphites). *Chronic rheumatism* and *gout* in which bad hygienic surroundings have given rise to almost a true cachexia are better treated with this oil than with anything else. In these cases the internal administration should be supplemented by daily inunctions of the affected joints. In *rheumatic gout* the same treatment is often of benefit. That form of *conjunctivitis* in children where there is great intolerance of light, the eyes being kept closed except in a darkened room, improves very rapidly under its use and that of astringent collyria and instillations of atropine, which latter, if used alone, afford little relief. The coryza, otorrhœa, and generally ill-nourished condition which often follow *scarlet fever* and *measles* need little beyond a systematic course of this oil, combined with such tonics as may be indicated. Functional nervous disorders, such as *chorea*, *epilepsy*, *neuralgia*, etc., are so generally accompanied and aggravated by general malnutrition that the specific remedies for these particular conditions do not have their proper effect. Under such conditions nothing will be found so useful as the oil, supplemented by the phosphites and hypophosphites of calcium, the specific treatment not being neglected. Brilliant success follows its use in all cutaneous diseases having a strumous origin, such as *impetigo*, *psoriasis*, *scleroderma*, *chronic eczema*, *favus*, *ecthyma*, and *lupus*. In the two last named iron adds to the efficiency of the treatment. In some forms of *chronic laryngitis* and *pharyngitis* the oil may be regarded as a specific, but, unfortunately, there are no indications as to the particular cases in which it will prove of benefit. All *cachexiæ*, especially that due to the prolonged use of iodide of potassium in the treatment of syphilis, are much mitigated by its use, and the occurrence of the latter form may be prevented by its administration from time to time during the use of the iodide. The *dizziness*, *vertigo*, and other *functional disturbances of the nervous system* in persons past middle life, due probably to atheroma of the arteries, are usually relieved by the oil, but to be effectual its administration must extend over a considerable period. Large doses are not usually necessary, but to gain the full benefit from the oil the phosphites and hypophosphites and iron must be used simultaneously. The *chronic diarrhœa of young children* which drags along without there being any assignable cause for it, and which yields little to ordinary treatment, is no contra-indication to the use of the oil, provided it does not materially increase the number of the stools or otherwise disturb the digestion, and indeed it is often the only treatment which affords any benefit.

Inunction with cod-liver oil, although extremely disagreeable to the patient and to those coming in contact with him, achieves such signal success in the treatment of certain cases that the advantages more than counterbalance the disadvantages. The cases in which it proves most useful are those of children in whom there is *marasmus* or a generally *perverted nutrition*. Almost immediately after beginning the inunctions a change for the better is seen, and in a short time a condition of health is usually reached which is hardly con-

ceivable except to those who have practised this form of treatment. For this purpose the dark-coloured and cheaper oils may be used, as there is no appreciable difference so far as offensiveness is concerned between the dark and the light. One inunction daily is usually sufficient, except in severe cases, and previously to it the whole body should be washed with water containing a small amount of ammonia or soda, both to remove the oil which remains from the preceding inunction and to thoroughly cleanse the skin so as to facilitate the absorption of the oil, which should be warmed slightly before it is applied. It is well to avoid the portions of the body uncovered by the clothing, also the folds and creases of the skin, as sometimes a chemical decomposition occurs, setting free the fatty acids, which in those situations would give rise to raw surfaces. Occasionally it will be found that persons who are unable to take the oil internally will acquire the ability after inunction has been practised for a few days.

A prejudice seems to exist against the employment of cod-liver oil during warm weather, but this is unfounded, the only precautions necessary being that the oil be kept in a cool place and the doses made a trifle smaller than during the colder months.

The principal uses to which cod-liver oil has been put have been enumerated, but in addition it may be stated that all conditions in which there is loss of flesh and strength are benefited by its proper administration.

Russell H. Nevins.

COFFEE.—The seed of *Coffea arabica*, a small tree of Arabia and Abyssinia, cultivated widely in tropical and warm climates. Coffee is not official, though *Coffea arabica* is recognised as one of the sources from which caffeine is to be derived. Besides caffeine, coffee contains fatty matter, a volatile oil, sugar, gum, and a peculiar variety of tannin called caffeotannic acid. A "caffeic" acid is also said to be an ingredient. These constituents (save caffeine, and by some caffeine is thought to be to some degree changed) are, however, subjected to considerable change by the process of roasting the coffee, and in its raw state it is very rarely used.

The chemistry of roasted coffee is not thoroughly understood, but with this procedure there develop in the seed an odour and a flavour that are highly characteristic. These are dependent upon a number of volatile substances developed by the process of roasting, and sometimes collectively known as caffeone. Among them caffeol, an empyreumatic oil ($C_8H_{10}O_2$), is the most important. Caramel, too, is formed by the conversion of the sugar the seed contains, and contributes its odour and its taste. In roasted coffee, therefore, are found both caffeine and caffeone, and on their presence the activity of the drug depends.

While the caffeine exerts the larger part of the physiological action of coffee, much of it depends on the volatile substances, and the cerebral stimulation and activity produced by a cup of coffee are thought to be largely due to caffeone, since they are but slight after the administration of an infusion of raw coffee, although caffeine is present in it to the same degree. Moreover, experiment has shown that caffeone is opposed to caffeine in its action in at least one direction, for the effect of the isolated caffeone is to accelerate the heart's action and to lower the blood-pressure, whereas the effect of caffeine is the opposite. The effect of caffeone is, however, but transient, and after drinking a cup of well-made coffee the temporarily accelerated and softened pulse resulting from caffeone is soon replaced by one of slower rate and fuller volume, the result of the caffeine. A laxative property, too, resides in coffee which is not possessed by its alkaloid, but has been ascribed to the action of its caffeone, and to this digestive activity of caffeone are attributed the dyspeptic symptoms resulting from a prolonged or excessive use of coffee as a beverage.

Further than these, the effects of coffee, as roasted and prepared for use in the ordinary way, are those of its alkaloid (see Caffeine). Thus coffee relieves fatigue and mental weariness, produces wakefulness, strengthens the cardiac force, and increases the blood-pressure. Like caffeine, it diminishes tissue waste and, though in no sense a food, thus makes a lesser amount of food sufficient. The excretion of urea is thought to be diminished by coffee.

The general use of coffee as a beverage by the civilized people of the world has led to the belief that it is an essential in diminishing tissue waste, and hence should be held an essential in our dietary. The fact that the greatest bodily and mental activity are quite compatible with an entire abstinence from coffee and similar drugs is, however, sufficient evidence to the contrary (Bartholow). Indeed, there are persons who are distinctly injured by their use. The contra-indications usually accepted are childhood, neuroses, cardiac diseases if accompanied by overaction and palpitation of the heart, lithæmia, and, in general, gastric, intestinal, and hepatic disturbances. In suitable cases, however, its action is quite as strong for good, the cup of black coffee following a hearty dinner being a direct aid to digestion, and the morning cup of coffee a stimulant to peristalsis.

The excessive use of the drug is, however, potent for harm in all cases, both nervous and digestive disturbances resulting and often reaching a severe grade. Thus, from the abuse of coffee result headache, dizziness, confusion of ideas, palpitation, tremors, dulness, and wakefulness—in fact, a group of symptoms often described as "nervousness," the digestion showing its disturbance in anorexia, flatulence, irregularity of the bowels, and the evidences of hepatic disorder to which the title "biliousness" is vaguely applied.

The impression prevails to a considerable extent among the French that coffee prepared with milk, *café au lait*, is far more productive of digestive disturbance than black coffee, *café noir*. That this is so lacks proof, though it certainly is the opinion of many, but it is to be recollected that the French *café au lait* is not our cup of coffee to which milk is added just

before using, but a preparation of coffee by infusion or decoction, the milk being employed throughout the process. Whether or not indeed this causes "biliousness," there seems no reason to believe that a cup of coffee containing milk, as used in this country, is any more productive of digestive disturbance than a cup of coffee not containing milk.

In preparing coffee for use as a beverage, the roasting and the grinding should have recently been done, since prolonged keeping of the roasted, and especially of the ground coffee, results in loss of those volatile substances on which the value of the drug so largely depends. It is safe to say that few articles of diet are so maltreated in their preparation as coffee is, and the nauseous draughts which the extreme of courtesy alone can call by the name of "coffee" are unfortunately the rule rather than the exception. A part of this dietetic wretchedness is no doubt due to the inferior grades of coffee used, as well as to adulteration, for from the former it is not to be expected that a superior drink may be prepared, and of the latter there is unfortunately a great prevalence. Yet even these do not account for it all, and the failure to observe the necessity of freshly roasting and freshly grinding, of which I have already spoken, add their part to the unpalatable result. More important than all, however, are the errors of final preparation for the palate, for the use of too prolonged boiling results in a total dissipation of those volatile elements upon which not only the delectability, but also a large part of the drug value of the coffee depends.

To properly prepare coffee, then, prolonged boiling should never be allowed; indeed, Bartholow puts the limit of temperature to be observed at 200° F. He recommends that to obtain the best result the coffee be steeped for some time in hot water. Though probably of less scientific and perhaps of less gustatory effectiveness than steeping, the method of preparation by percolation of hot water through the ground coffee results in a very satisfactory product, and the use of coffee pots acting upon this principle, which has so largely increased within recent years, has done much to improve our cup of coffee. To these coffee pots, as a class, the name "French" is often applied. With the temperature of the water employed in making coffee and with the duration of the process will the product vary, for to boil the coffee long must indeed be held a scientific as well as a gastronomic sin.

The therapeutics of roasted coffee depends largely upon the caffeine contained (see CAFFEINE), but certainly to some degree also upon its caffeone. In conditions of exhaustion and fatigue, whether mental or bodily, its effect is generally pronounced, and hunger, hardship, excitement, worry, and anxiety may undoubtedly be palliated by the judicious administration of well-prepared coffee.

Coffee causes wakefulness, and hence its application in narcotic poisoning is of great value. Especially is this the case in *opium poisoning*, and in no instance of such poisoning should its administration be neglected. In this condition heat, too, is indicated, so that the use of roasted coffee in hot infusion is by all means the wisest plan, and the quantity so administered is to be limited only by the patient's capacity and the requirements of his condition. The state of the patient, too, will determine the method of administration; if he is unable to swallow, the drug may be given by enema.

The depression and gastric disturbance so often encountered as a sequel of the therapeutic use of opium are wonderfully benefited by a cup of black coffee, and indeed no drug seems so competent to relieve this condition, the misery of which is not to be exaggerated.

The drinking of large quantities of strong coffee in health to produce wakefulness, that thereby necessary work may be performed, is, it need not be said, unnatural; while its occasional use for this purpose may not be productive of serious or even evident disturbance, its continued use in such cases is but a goad to a nervous system which, already weak, grows yet weaker with each administration, the evidence of its exhaustion lying in the somnolence by which Nature protests against the goad and calls for rest and sleep. If this warning is disregarded and the use of the drug continued, most unfortunate consequences may follow—consequences well described in the popular phrase as due to "a shattered nervous system" and clinically recognised as neurasthenia.

In *alcoholic poisoning* coffee is of great value. Whether it is simply a case of "overindulgence" or the more serious condition to which the term alcoholic poisoning is properly applied, coffee acts to refresh and to stimulate the threatened nervous system, and, with rest and warmth, serves often to determine a rapid and complete recovery. That the use of coffee in large doses may be followed by some depression is possible, but it is infrequently seen, and if present is slight and in no way comparable to the after-effects of alcohol.

Neuralgia is sometimes favourably affected by a cup of coffee, and *headache*, especially that form, of pure nervous origin, seen particularly in neurotic subjects and often due to excitement and worry, is at times relieved by coffee as it is by tea. *Migraine*, too, may often be benefited by coffee.

To those who live in *malarious districts* the use of black coffee, generally taken in the morning, has seemed of use as a prophylactic against infection, and certainly the drug so used would seem to be not without value.

Asthmatic paroxysms may sometimes be cut short by a cup of coffee. It is not invariably effective, and certainly not so reliable as nitrite of amyl or morphine; yet it is useful in a sufficient number of cases to make us class it among the drugs applicable to this obstinate and defiant affection.

Though it is true that coffee may disturb digestion and therefore its use in some cases may be inappropriate, the routine denial of coffee to the patient with fever simply because it is a part of his diet in health is absurd. Especially is this so if the patient is one whose use of coffee has been such that his comfort largely depends upon taking it. Coffee is a

stimulant, and so far from withdrawing it under these circumstances, its continuance is eminently appropriate, unless there is some more obvious contra-indication than the mere elevation of temperature. To one unaccustomed to the use of coffee its stimulant effects in *circulatory enfeeblement* will be even more pronounced. Its value, therefore, as a mild cardiac stimulant should not be forgotten, and because of its mildness it is especially appropriate for medicinal administration to children.

The usual method of administration is in infusion, but there are in the market fluid extracts of coffee both roasted and unroasted. The fluid extract of "green" coffee has been used by some who believe that the roasting process results in a diminution of the amount of caffeine contained in the seed, and by them the unroasted coffee is considered medicinally more active. This effect of roasting is, however, more than doubtful and the use of this preparation of the green coffee is now slight. The use of the fluid extract of the roasted coffee, while by no means so extensive as that of the extemporaneous infusion, is occasionally resorted to. The strength of the infusion ordinarily used medicinally is that of 1 oz. of the roasted and ground coffee to 1 pint of boiling water.—Henry A. Griffin.

COGNAC.—See under Alcohol.

COLCHICUM. — This has long been a prominent remedy against *gout*, and it is probable that it is an active ingredient in all the nostrums for the cure of this disease that are in any way efficacious. It is useful in any of the various forms of gout, as a prophylactic against the gouty attack, during the attack itself, and in cases of chronic arthritis, also in various diseases due to the gouty diathesis. Colchicum is also a diuretic, increasing the flow of urine and the uric-acid elimination. The conflicting statements in regard to the elimination of uric acid as a result of the action of colchicum are due to the fact that the various experiments have been made while administering different diets. It is also an hepatic stimulant and a good cholagogue, improving the assimilation and favouring the discharge by the bowels of the products of incomplete digestion. Colchicum is to a slight extent a diaphoretic also, so that by promoting the functional activity of these several emunctories it probably acts beneficially as an antarthritic. But over and above this it is especially antagonistic to the gouty condition, and this antagonism is a problem still unsolved, for it is prompt and efficient often in cases in which it does not produce its marked physiological action, and in other cases before it produces such action. There are other drugs which cause similar effects upon the liver, the kidneys, and the skin, but they have not the same influence over gout that colchicum has, and it may therefore be called a specific in that disease.

[Colchicum has been used successfully by Brocq in the treatment of *recurrent boils*, in daily quantities of from $\frac{1}{2}$ to $\frac{2}{3}$ of a grain of the extract. (*Jour. de méd. et de chir. prat.*, Feb. 10, 1895.)]

When given in small doses, colchicum increases the flow of saliva to a slight degree, stimulates the secreting action of the glands of the gastro-intestinal tract, and increases the outflow of bile from the liver. When the drug is administered to the point of tolerance, either in small doses or earlier in large doses, a marked effect is produced upon the gastro-intestinal tract. It causes gastric disturbances, such as a feeling of heat in the epigastrium, nausea, sometimes vomiting, and marked catharsis accompanied by flatulence and pain; the urine is increased in amount and there is a slight moisture of the skin.

The symptoms of *colchicum poisoning* are vomiting and purging, the vomited matter being first bilious and then bloody; the stools are serous and then mucous and bloody; the circulation is depressed, the pulse being weak and rapid; and the skin is cold and covered with marked perspiration. There is often great muscular prostration with pain in the extremities. In some persons there seems to be a special susceptibility to the unpleasant action of colchicum, and in such persons a combination of small doses of opium with each dose of colchicum lessens greatly the tendency to produce unpleasant effects. The action of colchicum varies in different individuals, its effects, both physiological and medicinal, not being always in direct proportion to the dose.

[Both the root, *colchici radix* (U. S. Ph.), *colchici cormus* (Br. Ph.), and the seeds, *colchici semen* (U. S. Ph.), *colchici semina* (Br. Ph.), *semen colchici* (Ger. Ph.), are employed in medicine. The preparations of the root are the extract, *extractum colchici radicis* (U. S. Ph.), *extractum colchici* (Br. Ph.); the acetous extract, *extractum colchici aceticum* (Br. Ph.); the fluid extract, *extractum colchici radicis fluidum* (U. S. Ph.); and the wine, *vinum colchici radicis* (U. S. Ph.), *vinum colchici* (Br. Ph.). Those of the seeds are the tincture, *tinctura colchici seminis* (U. S. Ph.), *tinctura colchici seminum* (Br. Ph.), *tinctura colchici* (Ger. Ph.); the fluid extract, *extractum colchici seminis fluidum* (U. S. Ph.); and the wine, *vinum colchici seminis* (U. S. Ph.). All these preparations call for great caution in their use.] In the treatment of poisoning with colchicum, tannic or gallic acid should be administered freely, and then copious vomiting induced.

The active principle, the alkaloid, *colchicine*, $C_{17}H_{23}NO_6$, a violent poison, is not much used, because of its irritating effects upon the gastro-intestinal tract. The most serviceable preparations are the acetous extract and the wine of the seed. The dose of the acetous extract is from $\frac{1}{2}$ to 2 grains; that of the fluid extract from 2 to 5 minims; that of the wine of the root, the wine of the seed, and the tincture, each, from 5 to 20 minims; the dose of colchicine is from $\frac{1}{120}$ to $\frac{1}{60}$ of a grain.

In persons specially susceptible to the influence of colchicum it is wise to begin with the smaller dose and give it at intervals of about three hours until the effect is produced of

either relieving the gouty manifestations or producing the gastro-intestinal disturbances to a slight degree, the effects produced governing the question of decreasing the dose or making the intervals longer. Sometimes more benefit may be obtained by combining a cathartic with colchicum. The celebrated anti-gout pill known as *White's pill* is a combination of colchicum with a cathartic, and consists of a grain each of acetous extract of colchicum, pulverized aloes, pulverized ipecac, and calomel. The dose is one pill, night and morning, until free catharsis is established. This treatment will often greatly modify the severest symptoms if employed early in an acute attack of gout, and in persons threatened with a gouty attack will frequently ward it off.—A. ALEXANDER SMITH.

COLD.—See BATHS, FRIGOTHERAPY, and REFRIGERANTS.

COLLODION, the *collodium* of the pharmacopœias, or contractile collodion, is a colourless, highly inflammable liquid having an ethereal odour, which dries on exposure to the air and leaves a thin, transparent film. It is prepared, according to the U. S. Ph., by adding 750 c. c. of ether to 30 grammes of pyroxylin, contained in a suitable bottle, allowing the mixture to stand for fifteen minutes, then adding 250 c. c. of alcohol, and shaking the bottle until the pyroxylin is dissolved. The bottle should then be well corked and set aside until the sediment has subsided, if there is any, when the clear portion is decanted and kept in cork-stoppered bottles in a cool place. The Br. Ph. directs that 36 parts of ether and 12 parts of rectified spirit be mixed, and then 1 part of pyroxylin added to the mixture, which is to be set aside for a few days and then decanted.

Dr. C. F. Schoenbein, of Basle, discovered in 1845 an organic compound soluble in common ether, which was introduced into the Swiss Pharmacopœia under the name of *liquor constringens Schœnbeinii*, though its discoverer gave it the name of *ether glue* or *ether balm*. He recommended its employment in the treatment of chilblains of all classes, of burns, of lesions of the skin, of swellings of the feet, etc. (*Lancet*, 1849, i, p. 289).

In 1848 Dr. S. L. Bigelow, of Boston, independently learned that a solution of gun cotton in ether dried, when applied to the skin, by reason of the evaporation of the ether, leaving a film that, by its contraction, brought the edges of an incised wound into much more intimate contact than sutures or adhesive plaster did, and kept them immovably fixed. The impermeability of the film precluded the possibility of the entrance of air, and, as it was impervious to water, the neighbourhood of the wound could be washed clean. As it was colourless and transparent, the surgeon could inspect the parts beneath the film without finding it necessary to remove it. It was then called liquid adhesive plaster, ethereal solution of prepared cotton, and gun-cotton varnish. The name collodion, first mentioned in the *Boston Medical and Surgical Journal* for March 29, 1848, originally a trade name, was adopted in England and France and became general.

Collodion has the power of dissolving or holding in solution a number of medicaments, and Dr. Gillette has arranged these solutions in the following classes:

Hæmostatic, styptic, and antiseptic collodions.	Collodion with perchloride of iron (6 parts to 1 part). Collodion with tannin. Collodion with phenol. Collodion with phenic, tannic, and benzoic acids (100, 10, 5, and 5 parts). Collodion with tannic and benzoic acids (80, 4, and 4 parts).
Astringent collodions.	Saturnine collodion. Ferruginous collodion.
Vesicating collodions.	Sinapis collodion. Cantharidal collodion.
Caustic collodions.	Bichloride-of-mercury collodion. Creosote collodion.
Sedative collodions.	Collodion with morphine. " " aconitine. " " veratrine.
Irritant and stimulating collodions.	Collodion with turpentine. " " arnica. " " capsicum. " " balsam of Peru. " " iodine. " " iodoform.

Anodyne colloid, or amyl colloid, is a non-official mixture of 1 oz. of hydramyl, 1 grain of aconitine, 6 grains of veratrine, and enough collodion to make 2 fl. oz. It is used as a local application for *neuralgias, lumbago*, and all *muscular pains*. The hydramyl rapidly volatilizes and the application often produces quick relief, but if the pain continues a piece of absorbent cotton or spongiopiline, wet with warm water, should be placed over the collodion film.

Belladonna collodion, *emplastrum belladonnæ fluidum*, is prepared by dissolving 5 parts of alcoholic extract of belladonna leaves in 3 of spirit of camphor, and adding 20 of flexible collodion. This preparation may be employed wherever belladonna plaster is indicated.

Bichloride-of-mercury collodion is a solution of 16 grains of bichloride of mercury in 1 fl. oz. of salicylated collodion. It is used for *venereal warts*. A *caustic collodion* is made by dissolving 4 parts of mercuric chloride in 30 parts of collodion. It is used as an escharotic for *nævi* and similar growths.

Cantharidal collodion will be found mentioned in the article on CANTHARIDES.

Carbolic-acid collodion.—See under *Styptic collodion.*

Cocaine collodion is a solution of 2 parts of cocaine in 100 of flexible collodion. It has been recommended for the cure of *chilblains* and to relieve *pruritus*.

Collodion with croton oil, *collodium tiglii*, is a mixture of 1 part of croton oil and 7 parts of flexible collodion; it is a useful counter-irritant, its action being limited to the part to which it is applied.

Creosote collodion is prepared by mixing 1 part of creosote with 3 parts of collodion. W. Adams recommends this as an application to the cavities of *carious teeth.*

Ferruginous collodion is prepared by mixing equal parts of tincture of ferric chloride and collodion. It is recommended by M. Aran as an application in *erysipelas;* though the rapid manner in which the tincture dries on an erysipelatous surface, and the probability that the alcohol has an equal effect with the iron in curing the disease, give little reason for substituting this collodion.

Flexible collodion, *collodium flexile* (U. S. Ph., Br. Ph.), *collodium elasticum* (Ger. Ph.), is prepared by mixing thoroughly 920 parts of collodion, 50 of Canada turpentine, and 30 of castor oil. This is more convenient in some instances than ordinary collodion, which is contractile.

Glycerized collodion, prepared by mixing 2 parts of glycerin and 100 of collodion, is flexible and does not scale off or crack like ordinary collodion.

Ichthyol collodion is a mixture of 1 part of ichthyol and 7 parts of collodion. It is an excellent application in *skin diseases* in which ichthyol is indicated.

Iodine, or iodized, collodion is a solution of 30 grains of iodine in 1 fl. oz. of flexible collodion. It affords a convenient method of applying iodine.

Iodoform collodion, *collodion iodoformatum,* is a solution of 5 grains of iodoform in 1 fl. drachm of flexible collodion. It is a good application to *venereal* or other *sores*, and for *orchitis* and *rheumatic inflammations.* Moleschott prepared this collodion by dissolving 1 part of iodoform in 15 parts of flexible collodion.

Salicylated collodion is a solution of 100 grains of salicylic acid in 1 fl. oz. of flexible collodion. It is an efficacious application to *inflamed joints*, as it exerts the action of salicylic acid and at the same time limits the movement of the joint.

Salicylic-acid and cannabis indica collodion will be mentioned in the article on SALICYLIC ACID.

Salicylic-acid and zinc-chloride collodion is a solution of 60 grains of salicylic acid and 30 grains of zinc chloride in 1 fl. oz. of collodion. It is used in the treatment of *corns, warts,* and *epithelioma.*

Salicylic- and lactic-acid collodion is a mixture of 10 parts each of salicylic and lactic acids and 80 of collodion. It is applied to *epitheliomata, nævi,* and various *small neoplasms.*

Salol collodion is a solution of 4 parts of salol in 4 of ether and 30 of collodion. It is used for the same conditions as salicylated collodion.

Saturnine collodion is prepared by adding, drop by drop, 30 parts of collodion to 1 part of a concentrated solution of lead acetate neutralized by an alcoholic solution of lime. It is used as an astringent in *erysipelatous inflammations* and in *wounds* and *contusions.*

Sedative collodions are prepared by adding morphine, atropine, or veratrine to collodion in the proportion of 1 part of the alkaloid to 30 parts of collodion. They are applied over *painful nerve tracts.*

Sinapis collodion is prepared by adding 3 parts of oil of mustard to 15 of collodion. It may be used wherever the topical action of mustard is desired.

Sulphural collodion was prepared by Mr. James T. Shinn by mixing 2 oz. of sublimed sulphur, 8 drachms of balsam of fir, and 1 pint of collodion. He also prepared an *iodo-sulphural collodion* in which iodine (8 dr.) was mixed with the articles composing the sulphural collodion. These are used in *skin diseases* in which sulphur or iodine is indicated.

Styptic collodion, *collodium stypticum* (U. S. Ph.), is prepared by dissolving 20 grammes of tannic acid in a mixture of 5 c. c. of alcohol and 25 c. c. of ether, and then adding enough collodion to make up the volume to 100 c. c. In an unofficial British preparation 1 part of benzoin is added to the mixture. Another unofficial preparation is *carbolic-acid collodion,* a solution of 20 grains of carbolic acid in 1 fl. oz. of styptic colloid. It is used as a styptic and to produce anæsthesia in small operations. *Pavesi's styptic collodion* consists of 3 parts of benzoic acid, 5 of tannin, 10 of carbolic acid, and 100 of collodion, thoroughly mixed.

The film left by the evaporation of the ether when collodion is applied to a part adheres firmly and undergoes contraction, and there is a certain amount of constriction, which may become painful when a large surface is covered, with consequent partial exsanguination. If a wounded or open surface has been properly cleansed so as to make it aseptic, the application of collodion, by excluding the air and all foreign substances, maintains the aseptic state. It is for this reason that collodion is so useful in surgery; the medicament itself is aseptic, and asepsis may be furthered by the addition of a variety of therapeutic substances. Small wounds simply require irrigation with a warm saline solution until cleansed of blood and all other material; the edges are then coaptated and collodion is applied to the surface by means of a small brush. A film is soon formed that will preserve the coaptation as well as a suture. For small incisions collodion is better than a suture; and in large incisions it has been employed to cover the sutures and the wound, though medicated gauzes have supplanted collodion for such purposes. In *scalp wounds*, in operations for *harelip*, and in those for *ruptured perinæum* collodion has been successfully used.

In cutaneous and other *ulcers* collodion forms an impermeable covering which prevents septic inoculation or traumatic irritation, and, like adhesive plaster, tends to approximate the cutaneous edges and further cicatrization. *Fistulæ* have been cured by the application of this agent, though it is necessary to secure a preliminary aseptic condition of the fistulous tract, otherwise the suppurative process will persist.

Caries of the teeth has been treated by cleansing the cavity and introducing collodion containing some sedative and antiseptic agent.

Superficial burns are benefited by applications of flexible collodion, to which sedative medicaments may be added where there is great superficial irritation.

The aperture of a compound fracture may be occluded by collodion, but at the present day the antiseptic gauzes are used for this purpose.

Saturnine collodion has been used successfully as an application for the cure of *varicose veins* and small varices or *aneurysms*. These latter have been cured with bichloride-of-mercury collodion, which is also efficacious in *condylomata*.

In cases of *retraction of the nipple* a zone of contractile collodion, from an inch and a half to two inches and a half wide, surrounding the nipple, is an efficient means of causing the projection of that organ.

When it is desired to apply some caustic or vesicating agent, a zone of collodion may be painted about the region to limit the action of the caustic.

The constricting effect of collodion has proved useful in *congenital hydrocephalus, meningocele, spina bifida*, and *umbilical hernia*.

Fissures of the nipple are successfully treated by covering them with collodion after preliminary disinfection. An application of collodion covering the entire breast will often relieve *mammary congestion* and prevent subsequent suppuration. To relieve *acute orchitis*, collodion is applied to the proximal portion of the scrotum, near the penis, and over the whole of the skin of the affected side, the application extending somewhat to the opposite side.

Sir Erasmus Wilson recommended this agent almost half a century ago as an application in *skin diseases* because it was a mild stimulant, an efficient substitute for the natural epidermis, and a mechanical and adhesive compress. It exercised a local alterative action on the congested capillaries of a part affected with chronic ulceration, and gave activity to the healing process. Being transparent, pliant, and impermeable, it was an excellent substitute for the skin. He found it beneficial as an application in *intertrigo, chapped nipples, chapped hands, herpes labialis* or *præputialis, herpes zoster, lichen agrius, lupus non exedens* and *exedens, acne vulgaris, chronic erythema*, and some affections of the sebiparous glands.

The application of flexible collodion in *erysipelas* gives almost instantaneous relief to the part, reducing the heat, redness, tension, and throbbing.

While flexible collodion does not prevent the suppuration or pitting of *small-pox*, it protects the pocks from flies and other insects and from the rubbing of the surface by the patient's hands, and thus answers a definite purpose.

In ophthalmology collodion is used to produce occlusion of the eyelids where it is desired to protect an uninfected eye from *catarrhal* or *purulent ophthalmia*. It may also be used for *ocular hyperæmia, aphthous conjunctivitis*, and *keratitis*. After a cataract operation the eyelids may be kept closed with collodion. Collodion has been recommended as an application over an eyelid for the relief of *entropion, trichiasis*, and *distichiasis*.

The *incontinence of urine* of young boys has been cured by the nightly application of a few drops of collodion to occlude the meatus or to produce closure of the prepuce, but this is a questionable procedure.

Dr. Barth makes an artificial membrana tympani by twisting out a piece of cotton wool for 4 cm. so as to leave a small tuft at one end: the handle thus made is dipped into collodion, allowed to dry, and in five or ten minutes the handle is tightly twisted and the tuft trimmed to fit the ear.

[A film of collodion is commonly spoken of as "impermeable," but probably it is not absolutely impenetrable, for when repeated applications are made of collodion holding in solution some substance capable of exerting a topical action, the action of that substance is greater than would result from a single application. This seems to show that the film first formed is penetrated by the drug at subsequent applications, perhaps with the aid of partial solution in the ether of the collodion applied afterward. Collodion is usually applied with a camel's-hair pencil, and it is well to have the pencil secured to the cork in such a manner that when it is not in use the brush will be immersed in the collodion, so as to prevent its getting dry and stiff. If this is impracticable the brush should be freed at once from the collodion that remains on it after it has been used. This may be done by rolling it between the thumb and fingers for a few seconds until the hairs are dry and separate.]

Samuel T. Armstrong.

COLLYRIA.—While perhaps not etymologically correct, this term will be held to include all liquid applications either to be instilled into the eye or to be applied to the conjunctiva by means of a camel's-hair pencil, the latter method being the most desirable when substances of an astringent nature are used, and the former when it is desired to produce the physiological effect of certain drugs upon the eye itself. The ordinary medicine-dropper is generally employed in the latter instance, and it should have a blunt point and a good-sized bulb. Those ordinarily sold have it too small and not of sufficient capacity. When it is used the patient should be made to look upward and the lower lid be drawn slightly downward and outward, thus furnishing a sort of pocket for the reception of the fluid, and after it has been instilled, contact of the point of the dropper with the eye being avoided, the eye should be closed for a few seconds. As a rule, astringents should not be applied in this manner, but the lids should be everted and the application made directly to the portion of the conjunctiva affected, and to that only, as the healthy conjunctiva is apt to react somewhat to these bodies, and more harm than good be done. Only a small quantity is to be taken on the brush, which should be used gently and not as if one were applying whitewash to a wall. What may be termed a cardinal rule in the selection of an astringent is that all salts of lead are inadmissible, for, if there is the slightest excoriation of the cornea, the lead is apt to be deposited and an unsightly black spot result. Very many of the proprietary eyewashes and lotions contain lead, and

many cases of irreparable injury have followed their use. While not a collyrium in the ordinary sense of the term, the popular household remedy alum curd—made by coagulating the white of an egg with alum—is also to be avoided, as, although somewhat astringent, it soon becomes warm, and then, acting as a poultice, aggravates the condition it is intended to alleviate. The same may be said of the application to the eyes of rags or sponges soaked in fluids, and even when cloths dipped in ice water are applied great care must be taken to renew them the instant they lose their chill. As a rule, astringent collyria are not advisable until the most active stage of *conjunctivitis* has subsided and the conjunctiva has become relaxed and the blood-vessels have become somewhat enlarged. Probably silver nitrate is oftener used in this affection than any other astringent, and for general purposes it is the best, provided there is no idiosyncrasy, which sometimes renders its application very painful, and provided it can be used in such a manner as to reach the affected parts only. Unless used by a specialist, the strength of these solutions should not be greater than 5 grains to 1 oz. of water, and a much weaker solution, say of 2 grains to 1 oz., should be used in the beginning, as there is more danger of their being too strong than too weak. As a rule, silver solutions should not be used oftener than every two days, and their use must instantly be abandoned if after the first application there is any permanent increase in the irritation. In *gonorrhœal ophthalmia* and *ophthalmia neonatorum* solutions containing from 10 to 20 grains to the ounce may be employed when the conjunctiva assumes a dark-red and velvety appearance. Unless very weak, all silver solutions may affect the cornea unfavourably, and it is a wise precaution to instil a few drops of a solution of common salt after their use. In mild forms of conjunctivitis, or after the severer varieties have yielded somewhat to more active measures, alum is probably the most convenient astringent, and may be used without harm in a solution containing 20 grains to the ounce. The patient's feelings are doubtless the best guide, however, and if this proves too irritating it may be diluted until it produces only a slight and temporary burning and smarting sensation. Collyria of this sort may be used two or three times a day if there seems to be any reason for them. A 5-per-cent. solution of boric acid is the most grateful application that can be made to the eyes, as it has an agreeable detergent and soothing effect. It may be used alone or as an addition to any astringent with which it is not chemically incompatible, and it is hardly apt to do harm, provided it is not applied in such a manner as to give rise to a poulticing effect. Often it will be found to give more relief when used hot, being applied, by means of a sponge or a rag, but it should not be used too often, as all hot liquids have a more or less irritating effect if used too frequently. Weak solutions of borax are sometimes useful and furnish a ready agent for the removal of the incrustations of dried mucus which so often accumulate upon the margins of the lids and in the corners of the eyes. Zinc sulphate, tannin and glycerin, and many other astringents, have been used in the treatment of conjunctivitis, but they possess no particular advantages over the substances already mentioned, unless, as is sometimes the case, idiosyncrasies exist. Whatever is employed, it is well to delay its use until the patient has been out of bed two or three hours, as there is always an increased vascularity of the conjunctiva in the morning which both disguises the real condition and causes the application of astringents to be more painful and of less value. In the acute stages of conjunctivitis it is better to begin the treatment by applying cold cloths over the closed eyes, and indeed this is often sufficient to entirely relieve mild cases, but care must be taken that they have no poulticing effect and that their use is not sufficiently prolonged to lower the vitality of the conjunctiva. Hot water, frequently applied, will often relieve many cases, and it may be used in conjunction with other treatment. There is a form of conjunctivitis sometimes observed in strumous children in which there are marked *photophobia* and *lacrymation*, the edges of the lids are excoriated, and there is a genuine spasm of the palpebral muscles, so that it is impossible to introduce anything between the lids. In these cases a whiff or two of chloroform will relieve the spasm, and not only assist the operator but seem to have some peculiar curative effect. In nearly all forms of chronic conjunctivitis local treatment is of little avail until the general health is built up with tonics and a generous diet. The solutions containing atropine, eserine, and other alkaloids used for the purpose of producing their physiological effects vary considerably in strength according to their uses, and the reader is referred to the articles in which they are specially treated of. In all cases distilled water must be used in the preparation of collyria, and to those containing organic substances a small amount of boric acid should be added, for otherwise micro-organisms are sure to develop in such solutions, and give rise to considerable irritation of the conjunctiva. It should hardly be necessary to state that in almost all cases the brushes employed in conjunctivitis should be disinfected carefully each time they are used or, what is better, a separate one kept for each patient, and that the utmost gentleness should be exercised in manipulating the lids, etc.—Russell H. Nevins.

COLOCYNTH, *colocynthis* (U. S. Ph.), *colocynthidis pulpa* (Br. Ph.), *fructus colocynthidis* (Ger. Ph.), is the dried fruit of *Citrullus Colocynthis*, peeled and deprived of its seeds. The U. S. Ph. is not very minute in its definition, for it requires only "the fruit of *Citrullus Colocynthis* deprived of its rind," but nevertheless the condition of dryness and freedom from seeds and rind demanded by the Br. Ph. is that in which colocynth is always employed. The fruit is sometimes referred to as "bitter apple" and "bitter cucumber." Though native to Turkey, it is also found in several parts of

Asia and Africa, and is said to be cultivated in Spain as well. As found in the market, it has the appearance of whitish or yellowish-white balls, usually somewhat broken and about 2 inches in diameter. They are light, spongy, and readily broken, often each into three wedge-shaped pieces. They consist of the pulp in which are embedded many flat, brown, ovate seeds. This pulp is the only portion used. Though odourless, it is possessed of an intensely bitter taste. The seeds, too, are bitter, but are medicinally inactive. The pulp contains an active and bitter principle on the presence of which the therapeutic value of the drug depends. To this has been given the name *colocynthin*, $C_{56}H_{84}O_{23}$. This active principle is probably a glucoside, though this has been disputed and some writers refer to it as alkaloidal. In appearance colocynthin is yellow and to some degree translucent. It is brittle and friable, fusible below 212° F., inflammable, soluble in alcohol, and somewhat soluble in water. The amount of colocynthin contained in the pulp is variously estimated as from 0·25 to 14 per cent. The pulp contains, besides its active principle, extractive, oil, resin, gum, and amyloid principles. Another substance, called *colocynthilin*, is said to occur in the pulp, but it is unimportant and is probably a resin.

In small doses colocynth will act as a simple bitter, but its action in large doses is as a drastic and hydragogue cathartic. Violent griping accompanies its action, and from overdoses there sometimes result bloody movements, dangerous inflammation of the intestines, and even death. Indeed, doses of moderate size are often productive of violent symptoms, and therefore the drug is one which is seldom administered alone. *Poisoning by colocynth* has not been infrequent, a circumstance for which its supposed action to produce abortion has been responsible, and in a number of cases the poisoning has been fatal. The fatal dose of colocynth can not be stated with precision, but death occurred in one case from taking a teaspoonful and a half of the powder. It has been alleged that catharsis will follow the rubbing of tincture of colocynth upon the abdomen, the skin being thought to absorb its active principle, and the hypodermic injection of colocynthin has resulted in increased intestinal activity. Neither of these methods, however, is made use of in medicine.

On account of its violence of action, colocynth is seldom used alone, but it is an admirable purgative for combination with other cathartic remedies, its addition to them in small amount serving to intensify and complete their effectiveness, and that without a disagreeable prominence of its own vigour. Combinations of colocynth with belladonna, hyoscyamus, or aromatics, too, are effective, the colicky tendencies of the colocynth being thereby lessened. It would seem that colocynth is a hepatic stimulant, and when given in purgative doses produces an increase of biliary flow, at the same time making the bile more watery. To this action both clinical and experimental observation bear testimony. By some colocynth is thought to have powers as a diuretic, and it has also been employed as an emmenagogue and as an abortifacient, though in the latter capacity it is certainly not efficient unless in doses which are unsafe.

The therapeutical applications of colocynth are few, its chief employment being, in combination with other remedies, as in the compound cathartic pill, for the relief of *occasional constipation*. That of bilious subjects seems especially benefited by colocynth on account of its power to promote hepatic activity. As a remedy for chronic and habitual constipation the extract of colocynth may be employed in a small dose given each morning before breakfast and combined with belladonna and nux vomica. It would seem, however, that there are several drugs more highly to be recommended for habitual constipation than colocynth, and notably cascara sagrada and aloes. Colocynth has been used to cause the disappearance of long-continued *dropsies* and *fluid effusions*, but this employment of it is one not to be recommended. Of greater usefulness is its administration in a full dose as a revulsive in *cerebral disorders*.

The use of colocynth is forbidden in cases of acute intestinal inflammation, and pregnancy should suggest caution in its employment and the avoidance of all save small doses, though the absolute withholding of the drug in that condition is unnecessary.

Colocynth pulp may be administered in powder, though as a matter of fact it hardly ever is. The dose is from 2 to 8 grains.

The alcoholic extract of colocynth, *extractum colocynthidis* (U. S. Ph., Ger. Ph.), is seldom given in this country, but is mainly used in making the compound extract. The dose of the American preparation, as a purge, is from 3 to 5 grains; that of the German preparation is up to ¾ of a grain. The compound extract, *extractum colocynthidis compositum* (U. S. Ph., Br. Ph.), is more used than the other preparations of colocynth. Prepared according to the U. S. Ph., it contains 16 parts of extract of colocynth, 50 of purified aloes, 6 of cardamom, 14 of resin of scammony, and 14 of soap. The dose as a laxative is from 1 to 3 grains; as an active purge from 5 to 20 grains. The preparation of the Br. Ph. contains practically the same ingredients, though in proportions somewhat different, colocynth pulp entering into it in the proportion of 1 part to 4½ nearly. The dose is from 3 to 10 grains. The maximum dose of the tincture, *tinctura colocynthidis* (Ger. Ph.), is 15 drops. The dose of the compound pill, *pilula colocynthidis composita* (Br. Ph.), is from 5 to 10 grains. The pill of colocynth and henbane, *pilula colocynthidis et hyoscyami* (Br. Ph.), is composed of 2 parts of compound pill of colocynth and 1 part of extract of henbane. The dose is from 5 to 10 grains. No other preparation containing colocynth is so much used in this country as the compound cathartic pills, *pilulæ catharticæ compositæ* (U. S. Ph.), though by some the vegetable cathartic pills, *pilulæ catharticæ vegetabiles* (U. S. Ph.), are preferred, since they contain no mercurial. (See CATHARTICS.)

HENRY A. GRIFFIN.

COLOGNE WATER, *cologne, eau de cologne* (Fr.), *perfumed spirit, spiritus odoratus* (U. S. Ph., 1880), *teinture d'essence de citron composée* (Fr. Cod.), is an alcoholic solution of several of the aromatic oils and is employed chiefly as a perfume. The U. S. Ph. of 1880 directs that *spiritus odoratus* shall contain 16 parts of oil of bergamot, 8 of oil of lemon, 8 of oil of rosemary, 4 of oil of lavender flowers, 4 of oil of orange flowers, 2 of acetic ether, 158 of water, and enough alcohol to make 1,000 parts. The French preparation differs from this in the omission of the oil of lavender and the acetic ether, in the addition of oil of orange-peel, and in the quantities employed, while commercially the greatest variation exists both in ingredients and in amounts. The therapeutical employment of cologne water is to give a pleasant odour to lotions and to the atmosphere of the sick-room, and to form an agreeable addition to water when used for sponging and bathing. In *pruritus* the application of a mixture of equal quantities of cologne and water will often result in relief, which, however, is usually but temporary. Spraying the head with cologne is an agreeable and often an efficient remedy for *headache*.
Henry A. Griffin.

COLUMBO.—See Calumba.

CONDURANGO, *cortex condurango* (Ger. Ph.), is the bark of *Gonolobus Cundurango*, but under the same head are included the barks of a number of shrubby vines found in South America and Mexico. When first brought to notice a few years ago it was highly vaunted as being an absolute specific in all forms of *cancer*, but it shortly proved to be of not the slightest curative value, although it has been found very useful as a palliative in *ulcer* and *cancer of the stomach*, allaying the gastralgia, catarrh, hæmatemesis, and vomiting (*Lancet*, April 20, 1895, p. 1004). It has feeble tonic, stomachic, and bitter properties, and is used in Central America and South America in the treatment of *syphilis*, for its assumed alterative effects. The dose is from 4 to 10 grains. The dose of an infusion of 1 part in 5 parts of cold water is from 1 to 2 fl. drachms. Hot infusions are not to be recommended, as heat coagulates the extractive matters of the bark. The dose of the fluid extract, *extractum condurango fluidum* (Ger. Ph.), is from 20 to 30 minims.—Russell H. Nevins.

CONFECTIONS.—The confections of the U. S. Ph. are *confectio rosæ* and *confectio sennæ;* those of the Br. Ph. are *confectio opii, confectio piperis, confectio rosæ caninæ, confectio rosæ gallicæ, confectio scammonii, confectio sennæ, confectio sulphuris*, and *confectio terebinthinæ.*

CONIUM (U. S. Ph.), *conii fructus* (Br. Ph.), hemlock fruit, is the full-grown fruit of *Conium maculatum*, gathered while still green and carefully dried. Hemlock leaves, *conii folia* (Br. Ph.), *herba conii* (Ger. Ph.), are the fresh leaves and young branches gathered from the wild plants when the fruit begins to form. The fruit, or seed, as it is sometimes called, is about an eighth of an inch in length and of a greenish-gray colour. The leaves are dark green and sometimes as much as two feet long, their odour is fœtid, heavy, and very disagreeable, especially when they are triturated with a solution of sodium or potassium hydrate, and is thought to resemble the smell of mice. The dried leaves have a less offensive odour and a bitter, nauseous taste. The odour of the fruit is less pronounced than that of the leaves, but by trituration with potassium or sodium hydrate solution it also becomes strong and offensive. Its taste is bitter. Conium is indigenous to Europe, but is cultivated in the United States. The name cicuta is sometimes improperly applied to conium. The medicinal activity of the plant depends upon the presence in it of a volatile alkaloid known as *coniine*, or *conine*, $C_8H_{17}N$. The quantity of this principle varies in different specimens of the plant, and there seems no doubt that the conium of warm countries is a more powerful drug than that growing farther north. The fruit contains more coniine than the leaves do, and is therefore medicinally more powerful, the ratio according to some authorities being as three to one, but the actual amount present, even in the fruit, is very small. Coniine is an oily liquid of a yellowish colour, of a disagreeable, acrid taste, and of a most offensive odour which is said to resemble that of the urine of mice, but which is not identical with the odour of the plant itself. It is freely soluble in alcohol, though but feebly so in water, and with about a quarter of its weight of water it unites to form a hydrate. Exposed to the air, coniine is gradually changed into a brownish resin, which is inert. It is decomposed by heat. With tannin it forms an insoluble compound. Coniine is a violent poison, and, though hemlock is innocuous to some animals, to man it is fatal if taken in sufficient doses. The hemlock of southern Europe is especially powerful, and there is good reason to believe that it was the poison used by the Athenians to kill condemned criminals, for Plato's description of the death of Socrates depicts symptoms that strikingly resemble those which we know are produced by conium. Two other alkaloids occur in hemlock, but they are certainly of lesser importance than coniine. They are methyl-coniine and conhydrine.

The local application of conium, it is said, may cause paralysis from an action upon the motor end-organs, and hemlock is often used in poultices for the relief of painful conditions. That any analgetic result is thus produced, beyond that which might result from a non-medicinal poultice, is difficult to believe, for there seems to be an abundance of evidence to show that the action of conium upon the sensory nerves is little or none, unless it is given in very large doses. The alkaloid, coniine, is exceedingly irritating to mucous membranes; hemlock itself is less so, but its preparations are acrid and there often occur as early symptoms from its internal administration irritation of the mouth and throat as well as nausea and vomiting. Indeed, nausea and vomiting are even said to follow the hypodermic administration of coniine. Further

than these, the physiological action of the drug is shown by the occasional occurrence of frontal pain or a sense of fulness, a feeling of heat in the head, and the regular occurrence of muscular fatigue and feebleness, generally beginning in the legs and spreading. With this there are apt to occur vertigo and disorders of vision, the latter being due to disturbance of accommodation. To produce a full development of these symptoms is more difficult in muscular subjects than in weak ones, for their resistance to the remedy is more pronounced; some degree of voluntary resistance, too, is not impossible, and active exercise is said to retard the development of the symptoms and even to prevent them. From poisonous doses an exaggeration of these symptoms results—the muscular weakness is extreme, the eyelids droop, the voice is feeble and even suppressed, the pupils are dilated, and vertigo, diplopia, and finally loss of vision occur. The mind is usually clear almost to the time of death, but occasionally delirium or coma is present. Violent palpitation of the heart has been described, and in some cases there have been convulsive movements due to asphyxia. Death takes place from paralysis of the muscles of respiration, the heart continuing to beat for some little time after breathing has ceased. The treatment of cases of poisoning consists in the prompt evacuation and cleansing of the stomach, the administration of tannin as a chemical antidote, and the employment of heat and stimulants according to necessity. Strychnine seems to be a physiological antagonist of conium, since it is a tetanizer, and is therefore doubly indicated by this and its value as a stimulant of the circulation and respiration. Belladonna also stimulates the respiration. If necessary, artificial respiration should be resorted to.

The action of conium, like that of curare, is a paralyzing influence which it exerts upon the motor nerves, the nerve endings being first affected, and then the trunks. Whether this influence extends to the spinal cord is doubtful, but some have thought it a moderate spinal depressant. The drug has no cerebral effect, consciousness being retained in cases of poisoning almost to the time of death, and cerebral symptoms of late development being due to asphyxia. The sensory nerves are unaffected by therapeutic doses, though their function is depressed by large or toxic doses, numbness of the extremities being occasionally observed in persons poisoned, and some degree of anæsthesia as death approaches. Upon the respiration no effect is produced, save by poisonous doses, which kill by asphyxia from paralysis of the respiratory muscles. The circulation is little affected by hemlock, though some primary slowing of the pulse has been noted, with a subsequent increase of rapidity. Opinions differ as to its effect upon the temperature, some alleging an increase from its use, while others think the temperature lowered. In therapeutic doses, at any rate, its action on the temperature is unimportant. No influence upon secretion is possessed by conium. The drug is rather rapidly absorbed from the stomach, and its effects may sometimes be observed in half an hour after its administration. The elimination takes place mainly by the kidneys, and is also said to be accomplished rapidly. The system soon habituates itself to hemlock, and where its prolonged administration is required a continuous but cautious increase in the doses is necessary.

Hemlock was formerly used extensively in medicine, but its field of employment has been so curtailed that it is now seldom prescribed. Its special value was formerly thought to lie in a supposed resolvent power over *tumours* of various sorts, *cancers*, and *chronic glandular* and *articular enlargements*, as well as in a local anodyne action upon *ulcerations*, both cancerous and simple. The deobstruent potency of the drug is not generally credited at the present time, but some still retain their faith in it. Surgery has, however, almost entirely usurped its position in the treatment of cancer, though there is good evidence of its power to heal cancerous ulcerations in some cases. As for its anodyne effect, clinical evidence to a considerable extent supports it, but there is certainly nothing in its physiological action which serves to explain it save only when pain is associated with and dependent upon muscular spasm, in which case its paralyzing action upon the motor nerves might be expected to make it an efficient application. So inexplicable does this anodyne power appear, when the element of spasm is not present, that some attribute it entirely to the action of heat and moisture which are provided by the cataplasm in which it is applied, and explain whatever success is observed by the value possessed by indifferent poultices in general. However this may be, the pain of ulcerating cancers may sometimes be relieved by the application of conium in a poultice, and Waring recommends the application of lint saturated in *succus conii* as an anodyne dressing. Care must be observed in these applications when ulcerations and abrasions exist, lest there result undue and dangerous absorption. Conium has been thought to have a special value in *genito-urinary affections* as a sedative and anodyne. Thus, it has been given internally in *dysuria* and as an antaphrodisiac, and *ovarian menorrhagia* has been treated by the use of vaginal suppositories containing each 1 or 2 grains of conium.

It is upon its power as a paralyzer of motor nerves, and thus as an antispasmodic, that the chief utility of hemlock depends. It must be confessed that even thus the drug is little used at the present time, but it is one to be borne in mind as applicable to spasmodic conditions and a most vigorous agent. In this manner there have been successfully treated *asthma*, *whooping-cough*, *angina pectoris*, *laryngismus stridulus*, *hiccough*, *chorea*, *spasmodic torticollis*, *paralysis agitans*, and *blepharospasm*, but to be efficient in any case the drug must be administered in doses sufficient to produce the milder of its physiological effects. In *epilepsy*, too, it has been employed, but is certainly no adequate substitute for the bromides, and its use in *spinal sclerosis* seems of little

value, the presence of organic changes in any disease seeming to make less the probability of its efficiency. In those grave convulsive conditions, *tetanus*, *hydrophobia*, and *strychnine poisoning*, coniine is strongly indicated. Though it has often failed, its failures would appear due rather to the inertness of the preparations used than to any fault of the remedy itself, and to its efficiency in *traumatic tetanus* Johnston bears testimony. With the intention of producing paresis of the respiratory muscles and thus diminishing pain and irritation, conium has been given in *pneumonia* and *pleurisy* with asserted good results, but it can scarcely be considered safe to give a remedy whose preparations are notoriously of variable and uncertain strength, and whose toxic powers lie in the production of respiratory paralysis, for the purpose of causing paresis of respiration in a disease such as pneumonia, where respiratory embarrassment is one of the greatest dangers.

In one condition conium is considerably used at present, and that is the violent manifestations of *mania*, its paralyzing action serving to enforce muscular repose. For this purpose it has been much used and highly recommended by alienists. The hypodermic injection of the alkaloid coniine or one of its salts is generally the form of administration employed, especially if combined with morphine, the latter serving to produce cerebral quiet. If coniine itself is employed, the dose is from ¼ to ½ of a minim by the mouth, while if the hypodermic method is preferred the dose to begin with should be $\frac{1}{10}$ of a minim, increased according to the symptoms. The combination of coniine and morphine, too, is highly recommended for *muscular spasm* coexistent with nerve pain. *Delirium tremens* has been treated with coniine; so also has *melancholia*. The antispasmodic effects of conium are evoked by inhalation, and the *vapor coninæ* of the Br. Ph. is said to be excellent in *irritative cough* and *asthma*, as well as in *acute laryngitis*. Other applications of hemlock are not wanting, for it has been tried and thought valuable in *diabetes;* combined with cod-liver oil it has been given for *phthisis;* and it has been used to arrest the secretion of milk and as an anodyne for the relief of *neuralgia*.

The preparations of hemlock are as many as its modern uses are few, the Br. Ph. being especially liberal in this respect. From the fruit are prepared the following: The alcoholic extract, *extractum conii* (U. S. Ph.), which is made with the aid of a small quantity of acetic acid. It is of pilular consistence. The dose is from ½ to 1 grain. The fluid extract, *extractum conii fluidum* (U. S. Ph.), would appear to be the most reliable preparation of all. The dose is from 1 to 5 minims. A special precaution in its use has been pointed out by Squibb, for the effect of diluting the fluid extract is to cause a dangerously potent precipitate which, if taken toward the end of the bottle, may cause the gravest of symptoms. Tincture of hemlock, *tinctura conii* (Br. Ph.), contains 54½ grains to 1 fl. oz. The dose is from 20 to 60 minims.

From the leaves there are prepared the following: Extract of hemlock, *extractum conii* (Br. Ph.), made by expression of the juice and evaporation to a pilular consistence. The dose is from 2 to 6 grains. Juice of hemlock, *succus conii* (Br. Ph.), composed of 3 parts of expressed juice and 1 part of rectified spirit. The dose is from ½ to 1 fl. drachm. Compound pill of hemlock, *pilula conii composita* (Br. Ph.), containing 5 parts of extract of hemlock, 1 part of powdered ipecac, and sufficient treacle to make a pill mass. The dose is from 5 to 10 grains. Hemlock poultice, *cataplasma conii* (Br. Ph.), composed of 1 part of juice of hemlock evaporated to ½ a part, 4 parts of linseed meal, and 10 parts of boiling water. A poultice made of the fresh leaves is also employed at times. Inhalation of coniine, *vapor coninæ* (Br. Ph.), containing ½ a fl. oz. of juice of hemlock, 1 fl. drachm of solution of potash, and 1 fl. oz. of distilled water. These are mixed and it is ordered that 20 minims of the mixture shall be put upon a sponge, in a suitable apparatus, "so that the vapour of hot water passing over it may be inhaled." Of hemlock leaves themselves, in powder, the Br. Ph. places the dose at from 2 to 8 grains.

The preparations of conium are all unreliable, because the quantity of the alkaloid, coniine, in the plant and in the preparations is variable, because coniine is volatile, and because it undergoes decomposition, especially if exposed to light and air. For these reasons the initial dose must always be small, and be increased according to the symptoms which result. The same caution must be observed when changing from the use of one preparation to that of another. In the continued administration of hemlock the doses will require frequent increase, for, as has been said, a tolerance of the drug is easily established. When sufficient in amount two doses daily will usually be enough to maintain the effect. On account of the uncertain strength of the preparations of hemlock it would be preferable if coniine could be substituted for them, for it is useful in all the conditions benefited by the drug itself. This substitution is in fact made at times, though strongly objected to by some writers. The ordinary dose of the alkaloid is from ¼ to ½ a minim. The fact that coniine is unstable, however, has led to the employment of several of its salts, and of these the best is the hydrobromide. This is said to be an excellent preparation for use either internally or by hypodermic injection. It is stable, it is crystalline, it is not disagreeable either in taste or in odour, and it is freely soluble both in water and in alcohol. The dose is from $\frac{1}{20}$ to $\frac{1}{12}$ of a grain, but this dose may be rapidly and considerably increased. Coniine hydrochloride and coniine benzoate have been used also.

Henry A. Griffin.

CONTRAYERVA, the rhizome of *Dorstenia brasiliensis*, is used as a stimulant to the digestion, in daily amounts of 30 grains of the powder; in larger amounts, from 1 to 2 drachms, it is diaphoretic.

CONVALLAMARIN, $C_{23}H_{44}O_{12}$, is a glucoside found in *Convallaria maialis* and

used for the same purposes as convallaria. It may be given in daily amounts of from $\frac{1}{6}$ of a grain to 2 grains. The instillation of a 2·5-per-cent. watery solution into the eye, repeated two or three times, causes an anæsthesia of the conjunctiva and cornea that lasts for hours. Some temporary circumcorneal hyperæmia follows.

CONVALLARIA.—*Convallaria maialis*, the lily of the valley, a liliaceous plant, is indigenous to Europe, northern Asia, and parts of the Appalachian region, the Alleghanies of this country. This plant has been used empirically and as a household herb in Russia for generations, but its introduction into practice in western Europe and in America is quite recent and due mainly to the experimental and clinical researches of Professor Germain Sée, of Paris.

In its physiological action on the animal body convallaria resembles digitalis very closely, and its prime advantage is that it forms an additional resource for the practitioner in cases in which the latter drug does not agree, or when it is thought advisable for any reason to change the form, while maintaining the character, of the medication. For instance, it occasionally happens that, either at the outset or later on, digitalis is productive of so much nausea that its use has to be suspended. It may then be found that convallaria is better borne by the stomach, and the salutary impression on the heart may be continued. Its action differs from that of digitalis as follows: 1. It is more strictly limited to the heart. 2. It does not so decidedly retard the beat—*i. e.*, it does not prolong the diastole to the same extent, but shows the cardiac action considerably, while augmenting the force of the ventricular contraction. 3. So far as we know at present, it is free from the imputation of having a cumulative action such as is ascribed by many to digitalis, and may, therefore, be given for a long time without the fear of an unpleasant surprise. 4. Its tendency to produce nausea is stated by most of those who have used it to be less than that of digitalis, though the author's experience has not been so fortunate. 5. Its diuretic action is not by any means so distinct as that of digitalis. Whether or not it has any effect upon the respiratory function is not well established; but it is safe to assume—and the writer's observations have tended to confirm this view—that a drug which so powerfully affects the circulatory function is not without influence upon the closely allied function of respiration. It does undoubtedly, in medicinal doses, bring about an increase in the arterial pressure. It is also of great value at times in correcting *aberrations of the cardiac rhythm.*

Therapeutically, as will appear from the foregoing account of its physiological action, convallaria is at times of the greatest use in correcting *irregularities of the circulation*, when these are not dependent upon actual degeneration. The latter point should always be remembered in prescribing the drug, as it has a positive as well as a negative value. For, after the administration of what should be a sufficient dose of convallaria, if there is no effect upon the heart or arteries, it is presumptive evidence, as in the case of digitalis, that the cells of the body are not in a state to respond to ordinary, perhaps to any, stimulation. They have lost their normal power of vital reaction—are degenerate. The bearing of this observation on both diagonsis and prognosis in an individual case is evident.

To enter more into particulars, convallaria is of use in the treatment of *valvular disease* when this is accompanied by irregularities of the rhythm or by actual obstruction to the circulation. In such cases the cavities of the heart are usually dilated, and the blood lags in the veins, the arteries being comparatively empty. Here convallaria, like digitalis, tends to empty the veins and fill the arteries. It is of particular value in *mitral regurgitation;* of considerable use in *mitral stenosis*, though not comparing with digitalis in the latter affection; and of less importance in the treatment of *aortic disease*, though here it is still a great help, especially if there is, as in aortic regurgitation, a decided tendency to dilatation of the left ventricle. It is also valuable as a remedy for *passive congestions* depending upon cardiac insufficiency, or where the work of the right heart is unduly increased, as in *pulmonary congestion*, in *pneumonia*, in *emphysema*, and in *pleuritic effusions.* It is serviceable, too, in *cardiac incompetency resulting from overstrain*, such as has been observed in soldiers after long, forced marches and in the long-distance pedestrians. These cases are characterized by excessive irritability of the heart, first accurately described by Professor Da Costa, by a tendency to palpitation and irregular action on the slightest exertion, and often by a feebleness which threatens to result in syncope at any moment. In such cases absolute rest is an indispensable adjunct to the treatment. But rest and proper nutrition having been provided, the *restitutio ad integrum* is greatly hastened by the proper employment of some such drug as digtalis, convallaria, cactus grandiflorus, or sparteine, in combination with bitter and ferruginous tonics. By virtue of the remarkable properties above detailed, convallaria, as well as the others of its class, is of great service in the treatment of *dropsies* when these are due to cardiac derangement. In *renal dropsy*, or the anasarca of such grave constitutional states as *leucocythæmia*, etc., it will avail little. The constitutional astringents and hæmatinics are indicated in such cases. Finally, it may be said that in many instances of chronic illness, such as *chronic phthisis* and the like, when it is necessary to strengthen the heart by all the means in our power, the long-continued use of convallaria and the other drugs whose action is similar to its own, alternating occasionally, or changing from one to another as they begin, through habit, to lose their power, is a very important though frequently overlooked means of restoring the normal circulation in the diseased organs.

We may say, then, that, except for its diuretic

(and, perhaps, antipyretic) effect, convallaria stands as a substitute for digitalis—an incomplete substitute, however, for its action is neither so strong nor so reliable as that of its great congener.

[The dose of the fluid extract, *extractum convallariæ fluidum* (U. S. Ph.), is from 5 to 15 minims.]—Benjamin F. Westbrook.

CONVALLARIN, $C_{34}H_{62}O_{41}$, is a purgative glucoside found in *Convallaria maialis.* It can not be recommended for medicinal use until further experience with it has been made known.

CONVOLVULIN, or rhodeorrhetin, $C_{31}H_{50}O_{16}$, is a glucoside constituting the active principle of jalap. It acts as a purgative in doses of from $1\frac{1}{2}$ to 3 grains.

COPAIBA (U. S. Ph., Br. Ph.), *balsamum copaivæ* (Ger. Ph.), is a resinous exudation obtained from several varieties of trees that grow in South America and the West Indies. It is amber-coloured, of a rather pleasant, aromatic odour, but of an intensely disagreeable and nauseous taste. It yields in abundance on distillation a volatile oil, oil of copaiba.

The earliest mention of it as a therapeutic agent was about the middle of the seventeenth century. At that time it was recommended as valuable in the treatment of leucorrhœa, diarrhœa, dysentery, and gonorrhœa; afterward it was much used in the treatment of bronchial and pulmonary affections; to-day it is rarely used except as an internal agent in the treatment of gonorrhœa.

According to some authorities its objectionable properties are so numerous as almost, if not quite wholly, to offset any curative powers that it may possess. Nausea, griping, diarrhœa, dysentery, strangury, cystitis, and gastro-enteritis are but a few of the many unpleasant results that are chargeable to it; and yet there are those who maintain with a considerable show of reason that, taking all in all, copaiba is the most reliable internal remedy at our command for the treatment of *gonorrhœa.* Its action, like that of all specific antiblennorrhagics, is probably largely, though not necessarily wholly, antiseptic in character. The vesical heat and tenesmus which it produces, the characteristic odour which it imparts to the breath and urine, all go to show that it passes from the alimentary canal through the circulation in a comparatively unchanged condition. Its excretion by the various emunctories, including the skin, is accompanied by such manifest vaso-motor stimulation as to make it highly probable that, to some extent at least, its beneficial action is of a general rather than specific character. Experiments are yet wanting going to show how far internal agents administered in the treatment of gonorrhœa or other infectious diseases may maintain through digestion, absorption, and circulation, any positive germicidal properties.

It can only be said of copaiba, in the light of our present knowledge, that, like creosote when administered in pulmonary tuberculosis, it appears in the treatment of gonorrhœa to exercise positively curative properties that can hardly be classed as other than specific.

To show the enormous quantities of the drug that have been consumed in the past, it may be noted that half a century ago over 150,000 pounds were imported annually into London. That it is much less generally in use to-day than at that time is unquestionable.

As with all medicines of its class, adulteration with inert agents, most frequently rape oil, is not uncommon. This is a matter, however, which concerns the pharmacist rather than the therapeutist; to him the doctor looks, as the patient does to the doctor, for good and efficient service.

Copaiba is rarely administered alone; indeed, the combination of it with some positive alkali so modifies its nauseous and other objectionable properties, and at the same time so enhances its antiblennorrhagic virtues, as to make it desirable in practically every instance to make some such combination of it.

The following, a modification of the old "Lafayette mixture," will be found to be excellent:

℞ Copaibæ.
Spir. ætheris nitrosi,
Tinct. lavandulæ comp.,
Syrupi....................āā f ℥ j;
Liq. potassæ.................. f ʒ ij;
Mucilag. acaciæ.....q. s. ad f ℥ viij.

M. S.: A tablespoonful three times a day, an hour after meals.

The simple syrup may be replaced by syrup of cinnamon, orange, wintergreen, or such other flavouring substance as may suit the fancy of the patient.

It should be taken directly from the spoon, and not earlier than from half an hour to an hour subsequent to each meal. It will be found to agree with the stomach in a surprisingly large number of cases.

Much debate has taken place in the past with reference to the period of the disease in which copaiba should be administered. One school, headed by Ricord, advocated withholding it during the early, acute stage, while another, represented by Bumstead, held that its greatest good effect was exercised in the acute stage rather than in the stage of decline. The latter school prevails to-day, and, while experience teaches the inadvisability of the injection method of treatment in the acute stage of gonorrhœa, practitioners quite generally agree that this stage is rapidly ameliorated by the early internal administration of specific antiblennorrhagics, and notably of copaiba combined with alkalies.

As will be seen, the amount of copaiba in the formula just given is half a drachm; much larger doses may be administered if they are tolerated, although, according to Milton, half-ounce doses are no more to be relied on than those of half a drachm.

The administration of copaiba in soft elastic capsules, or solidified by being incorporated with magnesia or alum and sugar, while permissible, is by no means so elegant or efficient a mode as that of giving the Lafayette mix-

ture. *Oil of copaiba, oleum copaibæ* (U. S. Ph., Br. Ph.), which is soluble in alcohol, may be used. The dose of it is from 10 to 20 drops.

As is the case with many of the nauseous medicines that require more or less digestion, copaiba, even when it is well tolerated at first, not infrequently palls upon the patient after a week or so of its administration. In such cases it should of course be withdrawn, either temporarily or permanently, and some other remedy of its class substituted for it. Ordinarily it is desirable in its exhibition that the patient should avoid copious diluents, in order that when it is excreted by the urinary apparatus its effects may be more pronounced; when, however, as is sometimes the case, backache, strangury, or hæmaturia follows its ingestion, the free use of some diluent is of course indicated.

Much stress was laid by the earlier writers upon the frequency of cutaneous eruptions resembling urticaria that accompanied its administration; while such eruptions may appear, and have been mistaken for scarlatina and other of the eruptive diseases proper, it is a matter of experience with the writer, in the daily use of this agent over a period of many years, that they are of exceedingly infrequent occurrence, and that when they do occur they give little or no distress to the patient and do not necessarily call for a withdrawal of the drug.

[Copaiba has been employed by Bronowsky as a diuretic in *cirrhosis of the liver*. He used it in daily amounts of 1½ drachm, in emulsion (*Am. Jour. of Pharm.*, Jan. 1894, p. 41).

In the *Therapeutic Gazette* for June 15, 1895, Dr. J. Abbott Cantrell says that the use of copaiba oil in the treatment of *psoriasis* has shown good results in his hands in cases in which other treatment had been employed without the slightest abatement of the trouble. In the first case, the patient, a woman, twenty-nine years of age, had always been healthy until the appearance of the psoriasis, which had first attracted attention in her seventeenth year. The disease had spread rapidly over the entire body, and at the time the author saw her the eruption occupied a great portion of the skin, the lesions being small and large, some of which had coalesced, making very large areas of affected skin. The lesions ranged in size from that of a pinhead to a patch or two which were about seven inches or more in diameter upon the back and chest, while those upon the abdomen were nearly as large. Those upon the extremities ranged from a pea-sized papule to lesions having a diameter of several inches, the latter of which had coalesced, forming an irregular patch. All the lesions were distinct, with abrupt edges, being covered with the characteristic silvery-white or mother-of-pearl imbricated scales. The girl stated, and she was corroborated by her physician, that the disease had had no abatement since it was first noticed, although she had never been without treatment for it. Dr. Cantrell found that she had been under almost all forms of treatment; and as the arsenic which she had been taking had made no alteration in the skin manifestation, he advised her to place herself under strict observation, and to take 5 minims of oil of copaiba in capsules three times daily. A good nourishing diet and free access to open-air exercise were also prescribed. He occasionally heard from the attending physician, and in the latter part of the sixth month of treatment the report was that the patient was free from lesions.

In the second case the patient stated that the disease had existed for fifteen years, that she had been continuously under the care of physicians, and that she had got some relief, but that the disease had never actually been cured. The eruption was found to occupy the back, the chest, and the head, and lesions were found scattered over the extremities. The lesions were papules as first witnessed, but they soon spread, until, at her visit to the author, he found some of the size of a bank note, while others had a diameter of seven or eight inches. The woman had always been in good health, and no one in her family had ever had psoriasis. Since that time, however, the author has had her younger sister under treatment for the disease. When first seen by him he placed her upon the use of 5-minim doses of oil of copaiba, with instructions that she was to keep under strict treatment for at least three months, at which time he wished to see her again. She presented herself at the appointed time, when it was found that the condition was decidedly improved; in fact, there were no new lesions present, the old ones were faded in colour, there was no scaling, and she was fairly comfortable. Her sister had not continued the treatment for more than a month, but all the lesions had disappeared, and there had been no return of them at the time of report.

The solidified copaiba, *massa copaibæ*, of the U. S. Ph., is a mass of pillular consistence made by triturating 94 parts of copaiba with 6 parts of magnesia and enough water to dampen the magnesia throughout.

The resin of copaiba, *resina copaibæ*, of the U. S. Ph., is the residue left after distilling off the volatile oil from copaiba.]

EDWARD R. PALMER.

COPPER.—Brunton states that internally copper leaves the irritability of the muscles unaffected, but diminishes the total amount of work they are able to do, and also causes powerful contraction of the blood-vessels. Pure copper is not used for therapeutic purposes. It was formerly used to make cooking utensils, but if they were not kept bright and clean a basic acetate of copper was formed which dissolved in the food and caused poisoning. The salts of copper are used in adulteration to give food stuffs a bright-green colour, and the arsenite is used to colour wall-paper, but the toxicity of that compound is due to the arsenic rather than to the copper. Arlidge states that operatives working in an atmosphere containing copper dust have an acquired pallour and are lean; if they were fair-haired, the hair is discoloured by the adherence of particles of copper. There is a greenish or purplish red stain on the gums in consequence of the ab-

sorption of copper. The workmen may suffer with colic, at times with vomiting, extreme prostration, and purging in which the stools are coloured green. Mechanically the dust may produce conjunctivitis and disturbances of the respiratory tract. Dr. Clapton and Dr. Burq held that as copper workers were not frequently affected by *cholera, choleraic diarrhœa*, or *typhoid fever*, the inhaled or absorbed metal was a prophylactic.

There are a number of salts of copper, included in two series, cuprous and cupric; none of the first-named are used medicinally, and of the latter only two are official.

[M. Luton, in a monograph on the use of copper salts in the treatment of *tuberculosis* (reviewed in the *Rev. internat. de bibliog. méd.* for July 10, 1895), says it is evident from the number of observations he cites that whenever copper has been employed in tuberculosis at the beginning a recovery has been obtained. In cases of gray granulation the method is said by M. Luton to be insufficient in itself to produce complete recovery, but, associated with a rational medical and surgical treatment, to give very good results. In the same way, says M. Luton, copper salts are a valuable adjuvant in cases of softening; *ganglionic abscesses*, manifestly perceptible under the skin, are amenable to puncture, but a much more rapid recovery has been obtained with general cupric treatment than with the ordinary procedures. In *tuberculous arthritis* it is an excellent adjuvant in the first stage, it is valuable in surgical therapeutics in the second, and in the third it completes what the operator has begun and prevents the disease from spreading. According to M. Luton, copper salts may be a valuable aid in all stages of the evolution of surgical tuberculosis as well as in non-surgical forms of the disease.]

Cupric acetate, *cupri acetas*, crystallized verdigris, crystals of Venus, $Cu(C_2H_3O_2)_2H_2O$, is formed when cupric oxide, or verdigris, is dissolved in acetic acid. It occurs as deep-green, prismatic crystals, which have a nauseating, metallic taste. This salt is poisonous and should not be given internally in doses exceeding $\frac{1}{16}$ of a grain; in case of poisoning the same measures should be adopted as are mentioned in discussing the treatment of poisoning by cupric sulphate. Cupric acetate is rarely used internally. It may be used topically in the strength of from $\frac{1}{4}$ to 1 per cent. in *conjunctivitis, aphthæ*, and *gonorrhœa*.

Aluminated copper, *cuprum aluminatum* (Ger. Ph.), *lapis divinus*, is made by fusing and moulding 1 part each of alum, cupric sulphate, and potassium nitrate, and adding enough camphor to equal in quantity $\frac{1}{50}$ of the whole mass. It is used as an application in *granular conjunctivitis*, either as a pointed stick or in a collyrium containing 1 part of the copper to 250 parts of distilled water.

Ammoniated copper, *cuprum ammoniatum*, is made by rubbing together in a glass mortar $\frac{1}{2}$ oz. Troy of copper sulphate and 360 grains of ammonium carbonate. The salt has a deep-blue colour and an ammoniacal odour, and it parts with its ammonia when exposed to the air. It was formerly official in the U. S. Ph. It was used in the treatment of *chorea, epilepsy*, and *neuralgia*. In large doses it may produce the toxic symptoms caused by the other copper salts. The dose is from $\frac{1}{6}$ to 1 grain, gradually increased and given in pill.

Copper arsenite, *cupri arsenis*, Scheele's green, is prepared by adding potassium arsenite to a solution of cupric sulphate. It is a grass-green, amorphous, insoluble powder that is largely used in the arts and is very poisonous. It has been recommended in minute doses as almost a specific in the treatment of *cholera infantum, cholera morbus, diarrhœa, enterocolitis*, and *dysentery*; but the writer has not obtained the results from its use that have been reported by other observers. The dose is from $\frac{1}{2000}$ to $\frac{1}{3000}$ of a grain every ten minutes, for an hour, then once an hour. For *chlorosis* and *functional anæmia* it is given in doses of from $\frac{1}{50}$ to $\frac{1}{25}$ of a grain two or three times daily; but in these conditions hæmoglobinometric examinations have not shown that it is superior to other forms of arsenic.

[In a work entitled *The Pocket Pharmacy* (New York, 1892) Dr. John Aulde, of Philadelphia, gave the following suggestions as to the preparation of solutions of copper arsenite:

"When used in the form of enemata, a single tablet containing one grain of the drug is added to a pint of boiled water, and to this mixture sufficient diluted hydrochloric acid is added drop by drop to effect solution, by which we obtain, in fact, a chlorarsenite-of-copper solution. For use in the mouth and nares and for vaporization in the treatment of tuberculosis, a solution is prepared by adding one tablet containing a grain to four ounces of boiled water, and sufficient diluted hydrochloric acid to make a clear solution; it should be passed through a filter to remove any sugar of milk or arsenous acid which may remain as a sediment. Experiments made with aceto-arsenite of copper, which is more readily soluble than the arsenite, proved unsatisfactory, owing to the precipitation of a considerable portion of arsenous acid, while a solution of the chlorarsenite is stable, showing no indications of deterioration after several months. Each thirty minims of the solution carries approximately a sixty fifth of a grain (one milligramme), and this amount may be used hypodermically in the treatment of tubercular affections every second day, and also in typhoid fever, without danger of abscess or any untoward symptoms other than follow the use of medicaments in this manner."

The solution was recommended by Dr. Aulde to be applied locally and taken internally in the treatment of *aphthæ*; in the form of a spray, after the preliminary use of hydrogen dioxide, in the treatment of *asthma*; also in the same manner for the relief of *bedsores*, to be followed by aristol as a dusting powder; in the case of *blepharitis*, to be followed by the use of purified petrolatum containing a small percentage of paraffin; for the relief of *cancrum oris*; in the form of a spray three or four times a day, in *acute nasal catarrh*, and the same in the case of *chronic catarrh*; in certain

stages of *cholera*, in the form of enemata; as an enema in *cholera infantum* and for *cholera morbus;* in the form of a spray or vapour for *croup* and for *diphtheria;* in the case of *enteritis* and *membranous enteritis*, in the form of enemata; in *glanders* it was recommended locally and internally; in *gleet* it was advised in the form of a solution three or four times a day, and also in *gonorrhœa*, *glossitis*, *œdema of the glottis*, *spongy gums*, *hay-fever*, *influenza*, *intertrigo*, *leucorrhœa*, *sore nipples*, *phthisis*, *prolapsus ani*, *puerperal fever*, *scarlet fever*, *scurvy*, *sneezing* (in connection with *hay-asthma*), *stomatitis*, *amygdalitis*, *tympanites*, and *yellow fever*.

In a letter published in the *New York Medical Journal* for Jan. 5, 1895, Dr. Aulde says: "In the case of *Asiatic cholera* and *yellow fever*, I have only advised its use on speculative grounds, but in all the other instances cited the recommendations are warranted from personal experience. In the form of a spray or by vaporization it has certainly shown remarkably good results in the treatment of *incipient tubercular affections* in conjunction with the hypodermic administration. I now recall a most interesting case of *chronic gonorrhœa* with orchitis which came under observation in December, 1891. The patient had been under treatment for several months; there was a muco-purulent discharge and the left testicle had attained to the dimensions of a good-sized orange. He came to me from New York on the way to his home in one of the Southern States and recovered fully in less than ten days. For the orchitic involvement the local treatment consisted in the application of ointment of red iodide of mercury (1 to 10 of benzoinated lard) and the addition of a suitable suspensory bandage."

Dr. A. Hrdlicka (*N. Y. Med. Jour.*, Sept. 29, 1894, p. 397) records a most favourable experience with copper arsenite. He has used it, he says, in *inflammatory derangements* of nearly all the *mucous membranes* of the body, from that of the gastro-intestinal tract to those of the eye, ear, nose, mouth, and pharynx on the one hand, and the urethra, bladder, vagina, and rectum on the other. The results have convinced him that it will control, alone or accompanied by other remedies and means, when administered in time and in the proper way, most of the acute and non-specific uncomplicated inflammations of these structures. With regard to the time of its administration during the course of the disease, he says, the earlier it is given the better and more rapidly it acts. The manner of its administration is purely topical, and he has found that it served best in solutions of from 1 to 50,000 or 100,000, which are easily made by dissolving one of the common $\frac{1}{100}$-grain pellets in either 1 or 2 ounces of water. They are applied frequently, at intervals seldom longer than an hour (in the case of the bladder, urethra, and nose), and often not longer than from ten to fifteen minutes.

The general characters of the cases which indicate its use, says Dr. Hrdlicka, are those of acute and subacute inflammations attended with pain, suffusion, and a more or less watery discharge. It has little action, he thinks, in cases where the discharge is thick and persistent, unless the affected surface is thoroughly cleansed by irrigation or lavage before the solution is applied.

In two cases of *cystitis*, one acute and the other subacute, salol and alkalies were administered at first, but were found insufficient, and arsenite of copper was resorted to. In the first case, one of acute cystitis in a woman following the introduction of a catheter after delivery, recovery set in within ten days. Warm lavage of the bladder with a 1-to-50,000 solution of copper arsenite was practised twice a day, and Vichy water was prescribed. At the end of five months, when the author made his report, there had been no further trouble with the bladder. The second case was one of subacute cystitis, also in a woman, which lasted for over three months. During the first month of the treatment copaiba and uva ursi were administered, and then salol and alkalies, but no material improvement followed. An examination for stone and gonococci gave negative results. At the beginning of the second month washing out the bladder with arsenite of copper was instituted and everything else withdrawn. Every other day the bladder was filled at first, and then washed with a warm 1-to-50,000 solution (90° F.), of which about three quarters were used at once. At first the bladder would not hold more than three or four ounces, but a rapid improvement followed each washing, and at the end of the second month the patient was discharged. The bladder capacity was then twenty-five ounces, there were no signs of disease, and the cure was permanent.

In three cases of *gonorrhœa* and in one of *proctitis* he has met with more or less complete success in the employment of this treatment.

In six cases of *otitis externa diffusa* arsenite of copper was used alone, and in two cases a little morphine was added, but it was found unnecessary, as the simple solution relieved the pain just as promptly. A 1-to-50,000 solution was used, and recovery set in in from one to three days in all the cases.

Five cases of *rhinitis*, one chronic and one subacute, were treated with copper arsenite by Dr. Hrdlicka. The chronic case was one of ulcerative anterior rhinitis of three years' standing, and the patient had never received more than temporary benefit from any treatment until the arsenite of copper was used. After the lapse of sixteen months she was apparently cured. A warm solution of 1 to 100,000 was injected into the nostrils from two to four times a day, as the conditions required. The trouble receded from the first, and only twice did an exacerbation occur; the bleeding and odour disappeared entirely in three weeks, and the ulceration healed in as many months, so that the patient was practically cured in four months, and further treatment, consisting of one application of the solution daily, was prescribed on account of the predisposition to a recurrence of the disease. The only internal remedy used was iodide of iron, the

employment of which, however, had to be discontinued. Of the other cases, three were very much benefited, but in the fourth, a peculiar case of periodical rhinitis, the remedy had no apparent effect.

In various *inflammations of the mouth* and *pharynx*, in twenty-one cases in which Dr. Hrdlicka used the arsenite-of-copper solution, he found it a most valuable adjuvant to other remedies. It yielded good results in a case of superficial *œsophagitis* due to swallowing hot bouillon. The aching and burning disappeared rapidly, and the next day the patient could swallow without experiencing pain.

In various *intestinal affections* he has used this remedy very extensively—in over a hundred cases—and, although it has not been uniformly effective, he recommends it most strenuously in suitable cases. If used alone it often fails in catarrhal complaints, as in *chronic* or *subacute gastritis* or *enteritis*. It is clearly indicated in acute inflammations of this tract attended with profuse watery secretions, pain, and rapid exhaustion—*i. e.*, *acute gastritis* and *cholera*. A type of disease most clearly indicating the remedy is the genuine *cholera morbus;* then come *dysentery* and *cholera infantum*.

In no cases, however, save perhaps in diarrhœal affections, have Dr. Hrdlicka's results been so uniform and brilliant as in the various acute and subacute forms of conjunctivitis. He had treated fifty-two patients with arsenite of copper up to the time of his writing his article, with good results. Among these cases twenty-one were traumatic, one was a case of *ophthalmia neonatorum*, and the rest were due to other causes. Pathologically, these inflammations ranged from a mere reddening of the conjunctivæ to the severest forms of effusion. These cases were associated with *phlyctænulæ*, three were combined with *keratitis*, and one was accompanied with *keratitis* and *iritis*. The duration of the treatment ranged from a few hours to two or three days in mild cases, and from several days to three months in complicated cases. At no time has the author observed failure, and in all the cases relief was "nearly instantaneous." The solution used was always that of $\frac{1}{100}$ of a grain of the drug (a tablet triturate) to 2 oz. of boiled or distilled water, applied by means of a dropper every ten or fifteen minutes until relief was obtained: after that every hour. Dr. Hrdlicka thinks that the effects of arsenite of copper are immediate, as a rule, in cases where it proves efficacious, and unless a very rapid improvement is noticed it would be useless to continue the remedy. He says that it appears to act in a triple manner: 1. As a cleansing agent. 2. As a soothing agent to the excited vaso-motor nerves. 3. As a cellular stimulant and tonic.]

Cupric nitrate, *cupri nitras* (Br. Ph.), $Cu(NO_3)_2 3H_2O$, is prepared by dissolving copper or cupric oxide in nitric acid. It occurs in blue deliquescent needles. It is used in the same doses and for the same purposes as the sulphate.

Copper oleate, *cupri oleas*, may be prepared by adding a solution of 3 parts of copper sulphate in 8 of water to a hot solution of 8 parts of castile soap in 32 of water, and washing and drying the pasty precipitate; when cold it forms a solid dark-green mass. In this mode of preparation there is a double decomposition, and the product is really an oleopalmitate of copper. It is used as an application when an astringent, antiseptic, and antiparasitic action is desired, as in *tinea trichophytina*, also in *warts, corns*, etc.

Ointment of oleate of copper, *unguentum cupri oleatis*, is made by melting and stirring together 1 part of oleate of copper and 4 parts of petroleum cerate or vaseline. This ointment is useful for *ringworm, indolent ulcers, warts, corns, freckles*, etc.

Cupric oxide, *cuprum oxydatum*, CuO, may be prepared by calcining cupric nitrate. It is a black or reddish-brown amorphous solid. It is not used internally. Hoppe recommended an ointment of 4 parts of cupric oxide in 30 parts of lard as an application in *chronic induration of the lymph glands*. It has also been recommended as a remedy for *gingivitis* and *tænia*.

Cupric phosphate, *cuprum phosphoratum*, is a compound of copper and phosphoric acid that occurs as a blue crystalline substance. Dr. A. Luton (*Rev. gén. de clin. et de thérap.*, 1887, p. 449) states that in its incipiency tuberculosis can be cured with cupric phosphate, the copper acting as a specific and the phosphorus as a dynamic agent. He gives pills containing $\frac{1}{6}$ of a grain of neutral cupric acetate and 1 grain of crystallized sodium phosphate once or twice daily; or these substances may be given in syrup of gum arabic, or $\frac{1}{6}$ of a grain of cupric phosphate itself may be injected hypodermically, dissolved in 10 minims of glycerin. The value of the remedy used in this way has not been reported upon by other observers.

Cupric sulphate, *cupri sulphas* (U. S. Ph., Br. Ph.), *cuprum sulfuricum* (Ger. Ph.), blue vitriol, blue stone, $CuSO_4 5(H_2O)$, is prepared by roasting cupric sulphide, or by heating copper with sulphuric acid, or from the water of copper mines. It occurs in blue, oblique prismatic crystals that have an astringent taste and an acid reaction and are soluble in water. By heating to 392° F., cupric sulphate may be deprived of its water, and a white anhydrous powder results.

This salt has virtually no action on the sound skin, but, applied to a part denuded of skin, it combines with the albuminous fluids and forms an albuminate of copper. Its astringent action is also marked when the salt is applied to mucous membranes, the tissues contracting and there being less secretion from the membrane. In strong solution it has a mild caustic action.

Internally, given in poisonous amounts, it produces violent vomiting and tenesmus, followed by exhaustion and death. There may be convulsions and paralysis. In smaller doses it is an emetic, producing vomiting which is not long continued, but ceases when the contents of the stomach have been evacuated.

Koch found that a 5-per-cent. solution of cupric sulphate diminished the vitality of a culture of micro-organisms in from five to ten minutes, but Sternberg found that a 20-per-cent. solution of the salt failed to destroy the vitality of the spores of the *Bacillus anthracis* and the *Bacillus subtilis* in two hours, though in a 5-per-cent. solution it destroyed micrococci. Sternberg considered that the germicidal power of this salt was superior to that of the corresponding salt of iron or of zinc, and that it was a valuable germicide for the disinfection of material which did not contain spores. It should be used in a solution of from 2 to 5 per cent.

As an emetic it is as efficient as zinc sulphate, and promptly produces nausea; it may be used in poisoning, especially by phosphorus. It has been used as an emetic in the treatment of *pseudo-membranous laryngitis*, in doses of 2 grains repeated every five minutes until vomiting occurs, but it is less likely to be useful in this condition than steaming or mercurial fumigation. A tablespoonful of a solution of 2 grains to the ounce of water, given every ten or fifteen minutes, has been recommended for *malignant sore throat*. Alone, or combined with opium, in doses of $\frac{1}{12}$ of a grain for children and of from 1 to 3 grains for an adult, by the mouth or by enemata, it has proved useful in *diarrhœa* and *dysentery*. Jackson recommended that it be combined with opium and given for the relief of *hæmoptysis*. Bull recommended its use in *phthisis*. It has been given in $\frac{1}{2}$-grain doses in the treatment of *typhoid fever*, and a number of observers have reported favourable results from its use in doses of $\frac{1}{4}$ of a grain in *intermittent fevers*. It has been used in *epilepsy*, but is inferior to several other remedies for that disease.

Locally, it may be applied either pure or in solution to arrest *hæmorrhage*, to stimulate *indolent ulcers*, and to disinfect and stimulate the granulations in *conjunctivitis*. It is an excellent application, in a solution of from 5 to 10 grains to the ounce of water, in *ulceration* or *mercurial stomatitis*, in *gangrenous pharyngitis*, and in *ulcerative colpitis* or *proctitis*. It is a popular remedy for *venereal ulcers;* and as an injection it is used, in a strength of from 1 grain to 2 grains to the ounce, for *gleet* or *gonorrhœa*. Diday recommended a solution of $3\frac{1}{2}$ grains to 1 oz. of water injected into *buboes*, and Pereira injected it to cure *hydrocele*. In *tinea tarsi* the solid sulphate is useful if applied after cutting off the eyelashes and removing the scabs. Locally, a solution of cupric sulphate is useful in *ichthyosis*, *psoriasis*, and *acne rosacea;* and internally it has been found useful, administered in small doses, in *erythema*, *ecthyma*, and *scrofula*.

An overdose of cupric sulphate causes vomiting, purging, and severe colic, and the vomited matter and the stools are greenish or bluish in colour from the salt. The above-mentioned symptoms may be followed by convulsions, delirium, paralysis, syncope, and even death. The urine and the vomit may be dark-coloured in consequence of the presence of hæmoglobin; jaundice usually occurs, and after death the liver is found to have undergone fatty degeneration. The gastro-intestinal symptoms in patients who survive are likely to be severe, and may follow in consequence of auto-intoxication. Milk or fresh eggs should be administered at once; soap or a fixed alkali is also useful, and vomiting should be produced as long as the vomit contains the copper salt. Opium should be given after the poison is removed, in order to control the nervous system.

As an emetic this salt may be given in doses of from 2 to 15 grains; as a tonic or astringent, in doses of from $\frac{1}{4}$ grain to 2 grains.

[**Copper carbonate** has been used as an antidote in *phosphorus poisoning* (see page 110).]

Samuel T. Armstrong.

COPRAOL is a fat obtained from crude palm oil. It resembles cacao-buttar. It solidifies at 82·4° F. (cacao-butter at 69·8°). As much as half its weight of a liquid may be incorporated with it without impairing its firm consistence on cooling.

CORIANDER, *coriandrum* (U. S. Ph.), *coriandri fructus* (Br. Ph.), the fruit of *Coriandrum sativum*, has aromatic and carminative properties, but is rarely used except combined with griping cathartics, especially senna. It may be given in doses of from 20 to 60 grains, and the oil, *oleum coriandri* (Br. Ph.), is sometimes administered in doses of from 1 to 4 minims.—Russell H. Nevins.

CORN SILK, *zea* (U. S. Ph.), *maydis stigmata*, is the styles and stigmas of *Zea Mays*, Indian corn, a native of America but cultivated extensively in all temperate climates. It occurs as yellowish or greenish threads, which are soft, silky, without odour, and possessed of a sweetish taste. Its medicinal activity is thought to depend upon the presence of maizenic acid. It is a diuretic of some effectiveness, the amount of urine being considerably increased, and at the same time it is a genito-urinary sedative and anodyne, especially valuable in *cystitis*, both acute and chronic. It has been used with success in *renal congestion*, *suppression of urine*, *pyelitis*, *lithiasis*, *renal colic*, and *hæmaturia*. In *chronic nephritis* also it is serviceable, and *albuminuria* is said to become less pronounced under its use. *Vesical irritability*, *cystitis*, and *prostatitis* are benefited by it, though the presence of much mucus in the bladder will interfere with its action by preventing its contact with the mucous membrane. The drug has also been directly applied to the vesical mucosa by irrigating the bladder with the fluid extract diluted with water. In *gonorrhœa* it is said to be excellent in the acute stage, especially if combined with potassium acetate. In *œdema* resulting from cardiac or renal disease its diuretic action is often of value, and under its action an *enfeebled heart* will often regain strength, the pulse becoming more regular and more forcible. There are several preparations of corn silk, but none are official.* The

* The U. S. Ph. mentions an *extractum zeæ fluidum*, but does not give the process of making it.

fluid extract, *extractum stigmatorum maydis fluidum*, may be given in doses of from 1 to 2 fl. drachms, repeated every two or three hours. The dose of the wine, *vinum stigmatorum maydis*, and that of the syrup, *syrupus stigmatorum maydis*, are each from ½ to 1 fl. oz. The infusion (2 oz. to 1 pint of boiling water) may be given *ad libitum*. An aqueous extract has been prepared of which the dose is from 5 to 10 grains, and maizenic acid has been employed in doses of ⅛ of a grain. Of these preparations, the infusion and the fluid extract are to be preferred.—Henry A. Griffin.

CORN SMUT.—Maize ergot (see under Ergot).

CORNU CERVI.—See under Ammonium carbonate.

CORNUS.—Various species of dogwood (*Cornus florida*, *Cornus sericea*, and *Cornus circinata*) were formerly employed as tonics and in the treatment of *malarial fevers*. An ounce or more of the powdered bark of *Cornus florida* was given between the paroxysms of fever. The U. S. Ph. of 1880 authorized a fluid extract, *extractum cornus fluidum*, of which the dose was from ½ to 1 fl. drachm.

CORNUTINE is an alkaloid obtained from ergot. It is a brownish, amorphous powder, sparingly soluble in water. The citrate and the hydrochloride dissolve readily in water. Cornutine seems to be the most intense of all the active principles of ergot. It has been used to some extent in the treatment of *uterine inertia*, various *hæmorrhages*, especially *menorrhagia* and *metrorrhagia*, and the atonic form of *spermatorrhœa*. To excite uterine contractions, from $\frac{1}{12}$ to $\frac{1}{6}$ of a grain may be given by the mouth, or from $\frac{1}{32}$ to $\frac{1}{8}$ of a grain subcutaneously; for hæmorrhages and for spermatorrhœa $\frac{1}{20}$ of a grain may be given by the mouth twice a day.

CORONILLA.—Several species of this hedysaroideous genus of plants have been used in medicine. *Coronilla varia* and *Coronilla scorpioides*, indigenous to southern Europe, have been found to act upon the heart like digitalis, but the effect is said to be very evanescent. They often act also as diuretics. A non-official tincture of the entire plant (1 part to 5 parts of alcohol) may be given in daily amounts of from ½ to 1 fl. drachm. The dose of the powder is from 15 to 30 grains. A poisonous glucoside, *coronillin*, contained in the plant has been used experimentally, but thus far the accounts are conflicting as to the dose required to produce a remedial effect. *Coronilla Emerus* was formerly used as an emetic and cathartic.

CORRECTIVES, CORRIGENTS, are agents that are added to a compound to correct or mitigate or altogether prevent its unpleasant action, but they are sometimes made to include also articles added in a prescription to improve the taste, the odour, or even the appearance of the medicine.

CORROSIVE SUBLIMATE.—See under Mercury.

CORYL.—This is the fanciful name of a mixture of ethyl chloride and methyl chloride which remains liquid at the freezing point of water, and hence is said to have some advantage over either chloride alone when used as a local anæsthetic acting by refrigeration.

COSMETICS.—The art of personal adornment has in all ages of the world been considered of sufficient importance to attract the attention of some of the ablest men. Hippocrates, Pliny, and Galen did not consider the subject beneath their notice. We read of the painted eyes, burning cheeks, and dyed nails of the ladies of Alexandria. The ladies of ancient Rome used a fine powder of calcined shells and the juices of certain plants to heighten their complexions. Cleopatra is known to have devoted much time to the study of cosmetics. In the limits of the present article it is impossible to consider all the means which have been used to render the body more beautiful and attractive, or indeed to mention everything used for this purpose at the present day. Perfumes and hair-dyes are included by some writers under the heading of cosmetics, and may perhaps be properly so included, but for the sake of brevity it seems best to the writer to confine his attention to articles ordinarily known as cosmetics, substances or preparations used to beautify the skin. Even of these only an outline can be given, and those who wish for fuller information are referred to various treatises on the subject.

Many, but by no means all, cosmetics are injurious; some are not only harmless, but, in certain conditions of the skin, actually beneficial, and it should be the part of the physician not to condemn cosmetics as a class, but to choose from them those which should be employed.

Some cosmetics are to cleanse the skin and make it fresh and soft, some to hide wrinkles, some to give the face a colour resembling the bloom of youth. Among those used to cleanse the skin and render it soft and white, soap should be included and given the first place. Soap is produced by treating any fatty substance, such as tallow, lard, butter, palm oil, cotton-seed oil, or oil of sweet almonds, with an alkali, either soda or potassa. Its discovery is ascribed by Pliny to the Gauls, who prepared it by mixing ashes with tallow. Common hard soap is made by the use of soda as the alkali. Toilet and "fancy" soaps are made by melting common hard soap with various colouring matters and perfuming them with aromatic powders or essential oils. Essential oils are irritating to the skin, therefore many highly scented and high-priced soaps are injurious to a delicate skin, although the soap itself is not harmful. The number of these toilet soaps is legion, but the best of all is a good white-curd soap without scent. Medicinal substances are frequently incorporated in soap, both for treating certain diseases of the skin and for cosmetic purposes. Some of these, such as tar, sulphur, and glycerin, are not objectionable when properly used, but some should be used with care.

It should be borne in mind that hot water is

bad for the complexion, and that cold water tends to make the skin fresh and soft, and when the use of the latter and good soap is supplemented by plenty of exercise in the open air there will be little need for other cosmetics.

Almond meal, or powdered almonds, is also an efficient preparation to cleanse and whiten most skins. It may be used either as a powder for the face during ablutions, or in small, fine muslin bags dipped into warm water and then applied to the skin, or as a powder to be applied with a puff while the face is still moist after washing. Usually almond meal renders the skin white, soft, and less sensitive, but occasionally it is found to be too drying and to make the skin rough and scaly.

Borax is also useful for the same purpose, and forms part of many cosmetics.

A soap-like preparation known as *eau athénienne* is pleasant and useful.

Emollients are particularly useful in winter and when the skin is dry, scaly, and chapped. First in the list is cold cream, *unguentum aquæ rosæ* (U. S. Ph.). This, as invented by Galen seventeen hundred years ago, was a mixture of grease and water, and, although the modern formula differs from his, it remains substantially the same. Several varieties are to be obtained, distinguished by their odours, such as camphor, almond, violet, rose, etc. The plain cold cream is prepared thus:

℞ Almond oil,
Rose water, each 1 lb.;
White wax,
Spermaceti, each, 1 oz.

The wax and spermaceti are melted in a water-bath, the oil is added, the mixture is again heated, and the rose water is gradually added while the mixture is being constantly stirred until it is all incorporated. It is then ready to be poured into jars, and the perfume, if any is desired, is put in at this time. While the essential oils enhance the pleasantness of the odour, they detract from the efficiency of the cream to soften and soothe the skin, on account of their irritating quality, so the simple cream is always the best.

Cacao-butter is an excellent substitute for cold cream, but vaseline is not so good, because on some skins it produces an unpleasant irritation resembling acne.

Almond paste is a very pleasant and useful emollient.

A lip salve made of equal parts of oil of sweet almonds and fresh mutton suet, with some bruised alkanet root, protects the lips and gives them a rich colour. A more elegant preparation is this:

℞ Almond oil, ½ lb.;
Spermaceti,
White wax,
Alkanet root, each, 2 oz.;

To this may be added, if the perfume is particularly desired, attar of roses, ¼ drachm.

Glycerin is a very popular cosmetic and generally useful, but it must be remembered that it is irritating to many skins, and usually it does not give satisfaction when applied to the lips.

Powders and paints are often used to whiten the skin, hide facial imperfections, and emphasize the colour of the cheeks. To render the skin white, powders of lycopodium, rice, starch, corn meal, magnesium carbonate, precipitated chalk, Venetian chalk, and oxide of zinc, tin, lead, or bismuth have been used. Magnesia, chalk, and the vegetable powders are not injurious when used in moderation, but the same can not be said of the others. Tin, zinc, and bismuth act injuriously on the skin, and quite a number of cases of lead poisoning have been reported as the result of the use of lead as a cosmetic. Rouges, or red paints, when composed of red lead, minium, mercury, cinnabar, or vermilion, are injurious, but do not seem to be so to such an extent when made of alkanet root, carmine, or cochineal. Berlin and indigo blue, mixed with talcum venetum, are used to paint false veins on the face. Eczema and pityriasis have frequently been caused by the use of paints upon the face, and their use should always be discouraged.

Sulphur is very useful in various skin affections, and is found in most proprietary preparations for the skin. In its use care must be taken not to employ a metallic preparation at the same time, because a chemical combination takes place which forms a black precipitate on the skin and renders it unsightly.

The aromatic vinegars, such as the "*vinaigre de toilette*," are popular as rubefacients, but are not good for the complexion if used extensively. They are occasionally useful to remove discolourations, such as black and blue spots.

Alcohol diluted with three or four times as much water is invigorating to the skin and is much preferable plain to the highly scented preparations widely advertised and used to preserve the complexion.

Certain of the resins and balsams whiten the skin, prevent sunburn, stimulate the glands of the skin, and gradually remove *freckles*. "Virgin milk," when a mixture of tincture of benzoin and rose water, is excellent for these purposes, but unfortunately it is frequently adulterated with vinegar of lead and is then injurious. *Eau de princesse*, as modified by Hebra, is also an excellent preparation.

Ointments, pastes, and lotions for removing freckles usually have corrosive sublimate as the base, and when used without due attention are apt to injure the complexion. The well-known *aqua cosmetica orientalis* is a good example of this class, and is made of 35 parts of corrosive sublimate, 7,600 parts of distilled water, the whites of 24 eggs, the juice of 8 lemons, and 280 parts of white sugar. Aromatic waters may be added for perfume if desired.

A continuous, scarcely noticeable desquamation of the skin and disappearance of freckles is produced by the following lotion:

℞
Emulsion of bitter almonds. 2 fl. oz.;
Tincture of benzoin........ 2 fl. drachms;
Corrosive sublimate........ ½ a grain.
M.

The following method is sometimes used to remove large freckles, but is much more severe. The skin is first rubbed with spirits of soap, then washed and dried carefully. A small compress dipped in a 1-per-cent. solution of corrosive sublimate is laid upon the freckle in such a manner that it has no folds and is in perfect contact with the skin, but does not extend beyond the pigmented area. For four hours this is kept moist with the solution, but not removed. The epidermis is thus destroyed, sometimes a blister is raised, and when the new epidermis is formed it is usually free from pigment.

In like manner less pigment is found in the skin after its removal by means of acetic, hydrochloric, or nitric acid, or the caustic alkalies, or their carbonates.

Repeated applications of the spirit of green soap cause the skin to fall in scales and the pigmentation to diminish, in much the same way as after the use of aqua cosmetica orientalis. The same result may be obtained by painting the skin with tincture of iodine, making frequent applications of borax, or the use of some such formula as the following:

℞ Zinc sulphocarbolate	2	parts;
Glycerin	20	"
Rose water	30	"
Cologne water	5	"

M.

Alum and mixtures of alum and borax are useful to remove red spots due to enlarged capillaries, such as redness of the nose from exposure to the cold. They are also recommended to correct disagreeable odours of the person, but for the latter purpose they are not so good as preparations of chlorine. These are generally in the form of chlorinated lime or soda, and are very efficient, when properly diluted with water, in correcting the odours from the feet and axillæ.

Matthias Lanckton Foster.

COSMOLINE.—See under Vaseline.

COTO BARK is obtained from botanically unknown trees native to South America. The name has been carelessly applied to several varieties of bark which, though similar, are not identical. Originally the bark was obtained from Bolivia, but a variety of coto has also been obtained from Brazil. The bark as usually found in the market is in pieces about a foot long, two or three inches wide, and from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in thickness. Externally it is of a brownish colour, but when freshly broken there are seen in it numerous yellow spots. Its odour is aromatic, especially when it is bruised, and its taste aromatic, burning, and slightly bitter. A bark very similar to coto and sometimes known by that name is more properly called *paracoto bark*. This resembles true coto bark strongly, both in appearance and in medicinal effects. It is milder in every way, however, its taste and odour being less pronounced and its therapeutic activity weaker. In true coto bark there are a volatile alkaloid, a volatile oil, resins, and tannin, besides the crystallizable body, *cotoin*, $C_{22}H_{18}O_6$. This occurs in large glistening crystals of a pale-yellow colour. It is slightly soluble in cold water, more soluble in hot water, and freely soluble in alcohol. In paracoto there occurs a similar substance, *paracotoin*, $C_{19}H_{12}O_6$, the colour of which is, however, paler, and its solubility in boiling water is slight.

Locally applied, coto bark is irritating; redness and burning follow if the powder is rubbed upon the skin. Given internally, the drug has a local action only. Upon the stomach it acts, in all but the smallest of doses, to cause irritation, and epigastric pain, nausea, and vomiting have resulted from the ingestion of 15 grains. The production of an increased amount of saliva is attributed to coto bark, but it seems probable that this is an accompaniment of the nausea rather than an independent effect of the drug. Its intestinal action is its most important one, for it produces dilatation of the intestinal vessels, and this Albertoni believes causes an increase of the nutrition and activity of the intestinal epithelium. Its value in *diarrhœa* is thus explained, for of astringency the remedy has little, and in health, moreover, it does not constipate. An antiseptic influence seems also to reside in coto bark, though this has been denied by some. It seems certain, however, that from its use there results a diminution of the amount of indican excreted, which would appear to support the theory of its antiseptic power. Its elimination takes place through the kidneys, and the addition of nitric acid to the urine of persons who are taking coto bark is followed by the production of a deep-red colour.

Though coto bark has been thought effective against excessive sweating, and has therefore been used for *hyperidrosis*, practically its solitary indication is in diarrhœa. In diarrhœa it is a drug of considerable value, especially in the atonic and chronic forms. Acuteness is not necessarily a contra-indication to its use, but demands the exercise of caution, particularly when the possibility of intestinal hæmorrhage is present. The remedy has been used with success in catarrhal diarrhœas, and those of typhoid fever and malarial disease, but its value has seemed particularly great in that of tuberculosis. Even *Asiatic cholera* is said to have been successfully treated with its similar, paracotoin, Professor Balz having given hypodermic injections of 3 grains in that disease. Locally, cotoin has been combined with 3 or 4 parts of starch or sugar, and the mixture applied to the pharynx as an irritant for the relief of *atrophic pharyngeal catarrh*.

There are a number of non-official preparations, of which the fluid extract and the tincture are probably the best. The powdered bark itself may be given in doses of from 5 to 10 grains, but the irritant effects of large doses must not be forgotten. The fluid extract, *extractum coto corticis fluidum*, may be given in doses of from 5 to 20 minims four or five times a day. The tincture, *tinctura coto corticis*, is made with 1 part of the bark to 10 parts of alcohol. The dose is from 5 to 15 minims, which may be repeated at intervals of two or three

hours. The active principle cotoin is preferred by some. The dose is from 1 to 2 grains. Paracotoin is given in doses slightly larger.—Henry A. Griffin.

COTOIN.—See under Coto Bark.

COTTON.—The commercial variety of cotton should never be used in medicine or surgery when there is any possibility of its coming in contact with raw or mucous surfaces, on account of the considerable amount of dirt, fragments of the bolls, etc., which it contains: it is also harsh and irritating, is of an unpleasant odour, is only slightly absorbent, and contains a varying amount of fatty matters. When, however, it is to be employed to maintain the warmth of a part or to pad fracture boxes (being for this last purpose inferior to hair or wool, as it is rather inelastic, and easily matted into compact masses), its relative cheapness will commend it in many cases. That which is ordinarily found in the shops is free from many of the objections mentioned, having been carded and cleaned, and is entirely suitable to be used to maintain the warmth of fractured limbs, to be applied to rheumatic joints, to cover poultices, etc. That which comes in thick sheets is the best, as the ordinary cotton batting is thinner and more easily disintegrated. Canton flannel, a heavy cotton cloth with a thick pile on one side, may be substituted for it in many cases; it may be used as a basis for plaster-of-Paris, starch, or sodium-silicate splints, and to line any form of apparatus where there is danger of friction causing abrasions.

Absorbent cotton, or purified cotton, *gossypium purificatum* (U. S. Ph.), *gossypium* (Br. Ph.), *gossypium depuratum* (Ger. Ph.), is ordinary cotton wool deprived of its fatty matters by treatment with alkaline solutions. It is less irritating than the ordinary untreated variety, is absorbent of fluids, and allows of their free passage through it, and thus may be used in place of filter paper when coarse precipitates are to be separated, but not when the solutions to be filtered are strongly alkaline or acid, and in many instances it may be employed in place of sponges in surgical practice and for the application of liquid remedies. Care should be taken to prevent its direct contact, in the dry state, with easily irritated surfaces, as small particles and threads are apt to be detached and be the source of considerable trouble. In surgery it is very largely used as a dressing for *burns, scalds, blisters,* and all lesions of continuity, whether accidental or intentional, but its contact with denuded surfaces must be prevented by the interposition of a piece of linen smeared with almost any unctuous body. As a covering to parts after operations it serves two ends, the one being the maintenance of an even temperature, and the other, and most important, the exclusion of septic organisms. To these purposes it is admirably adapted, as it is light and, while porous enough to allow of the passage of air and the escape of moderate amounts of secretions, is yet sufficiently dense to filter out any floating disease germs which may be present in the atmosphere. This latter property is strikingly manifest when it is used to exclude the air from previously sterilized putrescible solutions in wide-mouthed bottles or jars, all that is necessary being to insert a pledget of absorbent cotton loosely in the mouth of these vessels. In this manner these solutions can be preserved for indefinite periods. The important element in the use of this body to exclude septic micro-organisms after operations is the perfect sealing up of the wound and the parts in its immediate vicinity, which can easily be accomplished by care in adjusting the edges of the pad of cotton so that the entrance of air at those points will be impossible. If it is carefully applied, it is probable the simple absorbent cotton is as effective as the borated, benzoated, carbolized, iodoformized, or sublimated varieties, whose composition is sufficiently indicated by their adjective appellations. In making these medicated cottons, whatever agent is employed is dissolved in ether, alcohol, glycerin, or the like, and the cotton is thoroughly impregnated with the solution and allowed to dry. Iodized cotton is sometimes used in tampons in treating *ulcerations of the cervix uteri,* but it contains such a small amount of iodine as to be of little more value than tampons of plain cotton. In tamponing the vagina it is convenient to attach a number of pledgets of cotton to one long thread, leaving an interval of a few inches between them, so that when they are to be withdrawn the whole number can easily be pulled out by traction upon whatever part of the thread is taken hold of. Tampons may be impregnated with any drug that it is proper to use. Simple cotton tampons soaked in glycerin diminish local congestion to a very great extent. When saturated with a mixture of glycerin and tincture of iron chloride and allowed to dry, absorbent cotton is known as *styptic cotton.* It may be used to arrest slight superficial hæmorrhage, such as that from leech bites, to plug the posterior nares in obstinate epistaxis, etc., and is probably the least objectionable and most convenient of the styptics, although open to the objection of obscuring the condition of affairs beneath the grumous clot formed. Canton flannel, when subjected to the proper treatment, becomes absorbent and may be substituted for absorbent cotton with advantage when a thick protective covering is not needed.

Cotton-seed oil, the *oleum gossypii seminis* of the U. S. Ph., is the fixed oil expressed from the seeds of many species of *Gossypium.* It is bland and possesses slight drying properties. It is very extensively employed in the arts and as an article of food, and is often substituted in pharmacy for olive and almond oils, because it is much cheaper and in most instances equally useful. It is largely used to adulterate olive oil, which it closely resembles in taste and appearance, and, combined with the fat of pigs or with stearin, it constitutes the cheaper lards of commerce and is also made up into a number of substitutes for lard. These latter, when made of suitable materials,

are much to be preferred to the cheaper grades of lard, and usually possess better keeping properties. The oil itself is a very desirable article in which to fry foods, but on account of its low melting point is not so useful for shortening purposes as lard.

Cotton root.—The bark of the roots of a number of species of *Gossypium*, the *gossypii radicis cortex* of the U. S. Ph., has active emmenagogue and oxytocic properties and is held by many to be as efficient as ergot, but to be most active the roots must have been gathered when the plants had reached their full maturity. A decoction is made by boiling 4 oz. of the bark in a quart of water until the bulk is reduced to a pint. Of this a fl. drachm may be given in the same manner and under the same conditions as the fluid extract of ergot. A fluid extract, the *extractum gossypii radicis fluidum* of the U. S. Ph., may also be used in the same doses.—Russell H. Nevins.

COUMARIN, $C_9H_6O_2$, the fragrant principle of Tonka beans, has been used to mask the odour of iodoform, in the proportion of 1 part to 40.

COUNTER-IRRITANTS.—These are agents employed to irritate one part of the body for the purpose of diminishing morbid action in another. The method by which this result is accomplished has been the subject of much controversy, and is not yet thoroughly understood, although it has been believed by the majority of physicians since the beginning of the history of medicine that morbid processes can be influenced by this means. Our inability to explain this action logically has induced a certain amount of scepticism regarding its existence and its value in disease, but experience certainly seems to teach that its existence and value are real.

We know by observation and by the results of physiological experiments that superficial irritation produces changes in the nutrition and secretion of distant healthy organs. Thus, severe burns of the body, particularly of the abdominal walls, are apt to cause ulceration of the duodenum, and burns of the chest cause reddening and inflammation of the pleura and sometimes of the lungs. Physiologists have also demonstrated that irritation of the lumbar region induces contraction of the renal vessels, and that prolonged irritation of a large surface causes anæmia of the internal organs. As we know from these facts that the nutrition and secretion of a healthy organ may be influenced by a distant irritant, we are justified in believing that morbid processes in the same organ may possibly be influenced by a superficial irritant applied to a portion of the body not in direct contiguity with that organ.

The popular explanation of the action of these remedies, a theory approved by many noted writers, is that they draw away the blood from the affected part. It is in accordance with this theory that Mr. Furneaux Jordan, in *The Treatment of Surgical Inflammation*, page 16, recommends that the counter-irritant be placed over the brachial artery in cases of pleurisy or inflammation of the thoracic wall, over the femorals in abdominal and pelvic inflammations, and over the portion of the cervical region supplied by the external carotids in intracranial disease. The rule for applying counter-irritants in accordance with this theory has been thus formulated: "The counter-irritant should be applied over a vascular district collateral with the inflamed part." The scientific application of counter-irritants in accordance with this rule would require, since any tissue or organ may become inflamed, an intimate knowledge of the vascular system, a knowledge to which very few of us can pretend. Not only does clinical experience demonstrate this localization for their successful application to be unnecessary, but the theory itself is open to serious objection. When the diseased organ is in direct contiguity with the irritated area the dilatation of the small blood-vessels induced by the irritant may extend to the morbid portion, and so directly determine a change in the circulation of that part, but the amount of blood withdrawn from the general circulation by the dilatation of the vessels in the immediate neighbourhood of a small area of superficial irritation is so little that we can not reasonably believe it sufficient to deplete a distant organ appreciably. The best explanation yet suggested regarding these phenomena is that irritation of the peripheral nerves induces certain molecular changes in the nuclei of the nerves, and that these changes are transmitted to the trophic or vaso-motor nerves and produce trophic or vaso-motor changes in the organs supplied by them.

The purposes for which counter-irritants are employed are fourfold, viz., to affect inflammations or congestions, to promote absorption of inflammatory products after true inflammation has ceased, to relieve pain, and as general stimulants in cases of acute depression and narcotic poisoning.

The part to which, in any given case, it is advisable to apply a counter-irritant must be determined by a consideration of the purpose for which it is employed and the nature of the means proposed for employment. The milder forms, such as friction and heat, may be used much more freely and in closer proximity to inflamed tissue than it may seem advisable to bring a blister or the actual cautery. Attempts have been made to formulate rules for the application of counter-irritants in accordance with certain theories. Thus, the rule given above was that the counter-irritant should be applied over a vascular district collateral with the inflamed part. Dumontpallier, quoted by Dr. H. C. Wood, affirms that the best results are obtained by applying the counter-irritant upon the opposite side of the body, at a point exactly symmetrical with the seat of pain. To reconcile such widely different rules is impossible, and clinical experience does not demonstrate the absolute truth of either. In general terms, the proper place to apply a counter-irritant, as determined by clinical experience, may be thus stated:

To lessen congestion or inflammation, it should be placed at a distance from the affected part.

To promote absorption, it should be placed directly over the situation of the inflammatory product.

To relieve pain, over the seat of pain, or over the posterior root of the affected nerve.

As a general stimulant, on any portion of the body, particularly on the lower extremities.

Thus, in *encephalitis* a blister may be placed on the nape of the neck; to promote absorption of a *pleuritic effusion*, small blisters may be applied over the area of dulness on the chest wall; to relieve *gastric colic*, a mustard plaster or a hot-water bag may be laid on the epigastrium; in *opium poisoning*, flagellation may be employed on the body and limbs. But these rules can not be insisted upon arbitrarily, and there may be numerous exceptions to them.

Counter-irritants may be divided into rubefacients, vesicants, pustulants, and actual cauterants, according to the degree of their action.

Rubefacients are employed to produce a temporary congestion and irritation without provoking any decided alteration of the dermal structure. Care must be used in their application in order to produce this result, because most if not all of them will cause disorganizing inflammation if kept too long in contact with the skin. The principal members of this class are friction, heat, mustard, capsicum, ammonia, camphor, mezereon, arnica, alcohol, chloroform, ether, iodine, menthol, oil of cajuput, oil of turpentine, volatile oils, Burgundy pitch, and Canada pitch. As a class, they are employed much more commonly and in a far wider range of application than any other class of counter-irritants. In cases of severe pain, particularly when due to functional disturbances, such as *colic* or *lumbago*, the application of heat and mustard or other plasters is a well-known household remedy. In *neuralgia*, *sciatica*, and *pleurodynia* the use of heat, iodine, and menthol is equally well known. Turpentine stupes, which combine the effect of the hot water and of the turpentine, are useful in *peritonitis*, but in most forms of acute inflammation when counter-irritants are needed the stronger forms are to be preferred. As general stimulants, in cases of *narcotic poisoning* and *acute depression*, severe friction, heat, and mustard are usually employed. For this purpose rubefacients form the only class of counter-irritants advisable.

Vesicants produce the peculiar inflammation of the skin characterized by blisters. They are employed when a severer and more permanent effect than that produced by a rubefacient is desired. (See BLISTERS).

Pustulants affect isolated portions of the skin, giving rise to pustules. The principal ones are croton oil, tartar emetic, and strong solutions of nitrate of silver. The local inflammation produced differs in kind from vesication, it is very painful, and the pustules are slow to heal. The counter-irritant effect is similar to that of vesicants, but greater. Pustulants are only occasionally used, mainly to promote absorption of inflammatory products.

The **actual cauterants** employed at the present time are mainly Paquelin's thermo-cautery and the galvano-cautery. The moxa has been relegated, together with the suppurants, the seton, and the issue, to the limbo of the past. With the actual cautery a more powerful effect is obtained than with blisters, while the greater pain of pustulants is avoided. For this purpose it is not necessary to sear the tissues, as the rapid passage of the white-hot metal close to the skin often proves sufficient to induce the desired effect.

MATTHIAS LANCKTON FOSTER.

COUNTER-POISONS.—See ANTAGONISTS and ANTIDOTES.

COWHAGE.—See MUCUNA.

CREAM.—See under MILK.

CREASOTE.—See CREOSOTE.

CREOLIN, formerly known as *liquor antisepticus*, is a proprietary preparation supposed to consist of carbolic acid and certain other coal-tar products dissolved in water with the aid of resin soap. It is a blackish, syrupy liquid of an odour somewhat resembling that of carbolic acid, but less penetrating. Added to water, it forms a milky emulsion which is used, in the strength of about a fl. drachm of creolin to a pint of water, as a disinfectant. For disinfecting purposes creolin has about the same value as carbolic acid. It has the advantage of not affecting the hands unpleasantly, and the disadvantage of forming gummy deposits on instruments, etc., that are immersed in the emulsion.

Creolin has been used with some success in the treatment of *leprosy*, as will be seen by the following abstract of accounts of two cases published in the *China Medical Missionary Journal* for March, 1894:

The first patient, a young man seventeen years of age, had his arms, legs, and face covered with large, prominent leprous nodes, some of which had ulcerated. The skin over and around the nodes was anæsthetic, and beneath the skin innumerable smaller nodes could be felt. He was put under the influence of ether, and about fifty of the larger nodes were removed by making an incision in the skin and scraping with a Volkmann's spoon. The ulcers also were scraped and all the wounds were dressed with lint saturated with a mixture of creolin and glycerin. They healed rapidly, and afterward the whole skin, wherever nodes could be felt, was rubbed every day with the same mixture. This treatment was continued for nearly three months, and the patient was dismissed with no trace of the disease, except scars and a few anæsthetic patches on his arms and legs. The second patient, a man twenty-eight years old, noticed that his eyebrows had begun to fall off, and applied for admission into the hospital. He showed the characteristic appearance of leprosy; the upper lip was very thick, the outer half of each eyebrow was gone, the margins of the eyelids were thick and hairless, there was slight ptosis, and there

was constant lacrymation. Lepra bacilli were found in fluid taken from his face. The fingers were numb but not distorted. The mixture of creolin and glycerin was rubbed into the affected parts every day for about two months, and electricity was applied to the eyelids and to the hands. The improvement in this case, the author says, was slow, but satisfactory. The eyebrows began to grow, lacrymation ceased, and the lip was reduced to its normal size. The ptosis continued, and the eyelids were not very much improved in appearance, owing to the difficulty of applying the creolin to them, but the fingers regained their sense of feeling, and altogether the patient was much improved. The author saw him about a month after he had left the hospital, and up to that time there had been no return of the disease. The writer thinks that if leprosy is treated in its early stages it can at least be checked, but whether it can be eradicated remains to be proved.

The internal administration of creolin has been recommended in *infantile diarrhœa* in doses of from $\frac{1}{12}$ to $\frac{1}{8}$ of a drop every hour. Schwing's formula is:

℞ Creolin............2 or 3 drops;
Cinnamon water........3 fl. oz.;
Syrup..................1 fl. oz.
M. Dose, a teaspoonful every hour.

The ordinary dose for adults is from 1 to 5 drops three times a day. In much larger amounts it is reported to have been used with success in *Asiatic cholera*, about $1\frac{1}{2}$ fl. drachm being given in divided doses during the first few hours of the illness. When large doses are used it is best to give creolin in capsules or in granules made of an intimate mixture of the drug with kaolin.

Creolin is said to have been found serviceable in the treatment of *scrofula* and *chlorosis*.

CREOSOTAL.—See under Creosote.

CREOSOTE, *creosotum* (U. S. Ph.), *creasotum* (Br. Ph.), *kreosotum* (Ger. Ph.), is a highly complex substance consisting of a mixture of phenols, chiefly guaiacol and creosol. It is obtained by the distillation of wood tar, and the U. S. Ph., as well as authorities in general, express a preference for the tar derived from the beech, *Fagus silvatica*. Unfortunately, manufacturers are not generally actuated by the same motives, for a large part of the creosote in the market is obtained, not from wood-tar but from coal-tar, and is practically if not actually crude carbolic acid. That the adulteration of creosote or the substitution of carbolic acid for it is so easy is due to the fact that there is a striking similarity between them, not only in physical characteristics but also in physiological effects, and for the latter reason the substitution is less injurious than it otherwise would be. Some differences, however, there are, and carbolic acid is more potent and more actively toxic than creosote. It is therefore important that there be tests whereby the two drugs may be distinguished, and the following will be sufficient for the purpose: Creosote is possessed of a decidedly smoky odour, and carbolic acid is not. Carbolic acid coagulates collodion, and creosote does not. If a bit of pine wood is dipped into carbolic acid and then into hydrochloric acid it acquires in the course of half an hour a pronounced blue colour. In the case of creosote no such colour is seen. If to 10 c. c. of a 1-per-cent. aqueous solution of carbolic acid there is added one drop of the ferric-chloride test solution of the U. S. Ph., the solution assumes a permanent violet-blue colour, while the same test in the case of a saturated aqueous solution of creosote will result in the liquid's assuming a violet-blue colour, which, however, soon becomes greenish and then brown, usually with the production of a brownish precipitate.

In appearance creosote is a highly refractive, oily liquid, and when fresh is colourless, pinkish, or yellowish. Its colour deepens on exposure to light, however, and as obtained in the market it is usually of a reddish-amber tint. It has a pronounced smoky odour and a burning taste. It is soluble in about 150 parts of water at 59° F., but the solution formed is not perfectly clear. In 120 parts of hot water it forms a clear solution, but this on cooling becomes turbid from the separation of minute oil drops. In absolute alcohol, and in the fixed and volatile oils, it is soluble in all proportions.

The physiological action of creosote is practically the same as that of carbolic acid, though usually somewhat weaker, and poisoning from its use is relatively infrequent. Poisoning has occurred in a number of cases, however, but generally only from doses which were very large. The symptoms observed in such cases are dizziness, headache, dimness of vision, contracted pupils, depressed heart action, nausea and gastric disturbances, a tendency to stupor, convulsions, and coma. Trismus and cyanosis have also been observed. The amount of creosote necessary to produce toxic symptoms will vary much with the tolerance of the individual and greatly, too, with the rapidity with which the doses are increased; for, though a sudden onset of the symptoms of poisoning is possible from a single and relatively small dose given to one unaccustomed to the drug, it is more common for poisoning to be of the gradual or chronic variety and to result from the attempt to saturate the patient with creosote by doses gradually increased. Thus administered, the amount of creosote borne without ill effect has reached a daily total of several drachms. If the symptoms of creosote poisoning are of the acute variety and follow the ingestion of a large amount, the treatment will consist in evacuation of the stomach and the free administration of stimulants. If they are gradually developed, however—and in such cases there may occur a warning in the smoky discoloration of the urine like that seen from the ingestion of carbolic acid—the withdrawal of the remedy will usually be sufficient, though the administration of a soluble sulphate may be advisable and will prove antidotal, as in the case of carbolic acid.

The therapeutic value of creosote depends, as is the case with carbolic acid, entirely upon

a local action, for, though it is freely absorbed, no systemic action can be attributed to it, and whether its action is cutaneous following its application to the skin, gastric or intestinal from its ingestion, or pulmonary from its partial elimination by the lungs, it is in no sense a constitutional remedy, but essentially local in action. Externally applied, creosote acts as a nerve paralyzer, an anticnesmatic, an antiseptic, a caustic, a hæmostatic, a deodorant, an analgetic, and a stimulant. Applied to the normal skin, creosote acts mildly as a caustic, a white discoloration being produced. This action is taken advantage of occasionally in the cure of *warts*, the creosote being applied at frequent intervals. For this purpose creosote is certainly inferior to monochloracetic acid, and has the disadvantage of an exceedingly disagreeable smell. *Nævi* are treated in the same way, though the drug is usually more or less diluted. The results obtained in these cases are said to be excellent, excoriation and ulceration being produced and finally firm cicatrization. In skin diseases creosote is generally more useful if they are of the scaly variety. For *psoriasis* Tilbury Fox used an ointment of 6 drops of creosote, 6 grains of red oxide of mercury, and 1 oz. of lard. Creosote is useful also to relieve itching, indeed probably more so than carbolic acid. To relieve the itching of *chronic eczema* an ointment containing 10 grains of creosote to 1 oz. is recommended. As an analgetic, creosote is much used for the relief of *toothache*, being introduced into the cavity of a carious tooth upon a small pledget of cotton. It is furthermore often used in dentistry for its antiseptic properties as well as in compositions designed to destroy dental nerves. Creosote, though powerless against the more active forms of *hæmorrhage*, is valuable in capillary bleeding and oozing. Thus it may be applied for the oozing which follows amygdalotomy and similar operations, and creosote water has been applied to check *uterine hæmorrhage* and the *bleeding from leech bites*. As stimulants, antiseptics, and escharotics, applications of creosote are often made which range in strength, according to the severity of the case and the sensitiveness of the part, from 1 drop to 1 oz. of water, up to the pure drug. Thus are treated a large number of morbid conditions, among them *indolent* and *sloughing ulcers*, *fistulæ*, *gangrenous surfaces*, *leucorrhœa*, *puerperal metritis*, *fœtid otorrhœa*, *diphtheria*, *burns* with excessive suppuration and redundant granulations, and *chilblains*, and to wash out the pleura in cases of *empyema*. In *erysipelas* creosote may be advantageously applied mixed with 4 parts of lard, and a 1-per-cent. aqueous solution is recommended for use as a mouth wash in cases of *salivation*. Solutions of the same strength containing boric acid have been recommended as injections in the treatment of *gonorrhœa*. *Ulcers of the larynx*, whether tubercular or not, may be treated by the application of creosote, and a solution containing 1 or 2 drops of creosote to 1 oz. of water is useful as a stimulating and disinfecting gargle. For many of these purposes the official *aqua creosoti* may be used, corresponding in strength as it does to weak solutions of carbolic acid, especially for washing *suppurating surfaces* and for the *relief of itching*. Practically, therefore, the external applications of creosote are the same as those of carbolic acid.

The local application of creosote includes its inhalation, which is practised for a variety of respiratory diseases, notably *chronic* and *tubercular laryngitis*, *chronic bronchitis*, *bronchiectasis*, *pulmonary tuberculosis*, and *abscess* and *gangrene of the lung*. In these cases it is often efficient, acting to stimulate a healthier action of the affected tissues to render cough and expectoration looser and easier, sometimes to cause its diminution, and generally serving to correct fœtor and the odours of decomposition. In cases marked by a tendency to hæmorrhage, however, and where there is occasional blood staining of the expectoration, creosote is not to be inhaled, for it tends to cause bronchial hyperæmia, and may thus be the cause of harm. For the inhalation of creosote several methods are advised. It may be inhaled from boiling water, as is done in the case of the *vapor creasoti* of the Br. Ph.; it may be inhaled from a sponge or piece of absorbent cotton, and thus used seems especially satisfactory if combined with equal parts of chloroform and of alcohol; or it may be inhaled in a fine spray, for which a mixture of 1 to 2 minims of creosote, 4 grains of menthol, and 1 oz. of alboline* is recommended, to be used several times a day.

The action of creosote as a paralyzer of nerves and as an antiseptic is advantageously exerted upon the stomach and intestines, and the drug is frequently given to check *vomiting* and to correct morbid intestinal conditions. It is of particular value in disturbance of the stomach from *gastric fermentation*. The dose for this purpose is from ½ to 1 drop, taken after eating. Its sedative action may make it efficient in the *vomiting of hysteria* and in the reflex *vomitings of pregnancy* and *seasickness*. In *intestinal fermentation* and *intestinal dyspepsia* it is also a valuable remedy, and may be given in keratin-coated pills in order that gastric absorption shall not take place, the keratin yielding, however, to the alkaline contents of the intestine and liberating the entire dose of the creosote at the diseased locality. Its combination with an alkali, too, is highly to be recommended for conditions of fermentation, whether gastric or intestinal. Creosote is often used in *cholera morbus*, *cholera infantum*, *lienteric diarrhœa*, and even *typhoid fever* and *dysentery*, but it is to be doubted whether the two latter conditions are in any way affected by it, and of the others it suffices to say that the remedy is far more efficient in digestive disturbances which are unattended by acute inflammation. Creosote has also been used with supposed success in *diabetes*.

It is in *pulmonary tuberculosis* that creosote is chiefly employed, and its effectiveness in this

* Alboline, albolene, petrolatum liquidum, liquid vaseline, is an oily liquid obtained by the distillation of some varieties of petroleum. It is much used by laryngologists as a basis for medicinal sprays.

disease was formerly thought to depend upon a germicide power it possessed over the tubercle bacilli. To produce this effect it was given by inhalation, that it might encounter the bacilli directly, and was otherwise introduced into the body with the idea that in its partial elimination by the lungs it might have a similar action, while for a supposed greater effect its amount was increased practically to the extreme point of toleration. This belief is still retained by many, but the result of the vast amount of experimentation, observation, and discussion which has been expended upon the subject has been to convince the majority of writers that creosote has no specific influence whatever upon tuberculosis, and that, while it is beyond doubt beneficial in a large number of cases, its favourable effects are due only to its action as an expectorant and as a stomachic, the latter action being particularly important because of the gastric disturbance and fermentation so often present in the phthisical. Moreover, it is now believed that there results as much benefit from the administration of small doses (4 or 5 minims three or four times a day) as was formerly supposed to follow the daily administration of several drachms. In fact, these large doses are believed to defeat their own end, for they are not infrequently the cause of severe gastric disturbance, which means everything in a disease like tuberculosis, where the outcome is dependent largely upon the preservation of nutrition. The administration of creosote is highly to be recommended in pulmonary tuberculosis, but it should be given in the moderate doses already named. Its use must be continued for long periods of time, however, and if at any time there occurs digestive disturbance the administration of the remedy is to be stopped at once. So far as giving it by hypodermic injection is concerned, it is a perfectly rational procedure and may be done without harm, but it possesses no advantage over administering the drug by the mouth, and it can not be continued for a long period of time. The same may be said of creosote given in enemata; and so if creosote is not well borne by the stomach it is not worth while to give it at all. Not only are many persons with pulmonary tuberculosis not benefited by creosote, but some are even injured. Of those to whom it is unwise to give it are persons with a tendency to pulmonary hæmorrhage, for, as has already been said, creosote produces bronchial hyperæmia. In cases marked by a considerable amount of fever, too, the patients are benefited little or not at all, and the cases most wisely treated by the remedy are those in which the disease is yet slight, in which fever and emaciation are absent, in which the progress is slow, and in which digestion is well preserved. In renal degeneration most authorities find a contra-indication to the use of the drug, for it is eliminated mainly by the kidneys (probably as guaiacol sulphate and creosolsulphate of potassium) and in its passage through them is capable of causing irritation.

[Dr. John R. Conway, of New York (*N. Y. Med. Jour.*, June 1, 1895), upholds the doctrine of the specific curative action of creosote in tuberculosis, when used in large doses. He has used it in nearly four hundred cases, including not only the pulmonary form, but tubercular disease of the peritonæum, the joints, the bones, the glands, and the larynx. He lays great stress on the method of administration and on the quality of the creosote. He prescribes capsules containing 2 or 4 minims of creosote mixed with cod-liver oil. The dose, he says, should always be given immediately after eating and never on an empty stomach. He has always found that after several days complete tolerance is established, and within four or five days the dose can be gradually increased, until finally the stomach improves in every way, and all irritation with the accompanying indigestion has been relieved. In regard to the method of increasing the dose, Dr. Conway says the following rule will be found to work well: begin with 2-minim doses three times a day; in acute cases increase the dose by 2 minims every fourth day until 12 minims are given at one time, then observe the results of the largest dose for several weeks, and, if the improvement is not satisfactory, carefully add 2 minims more every eight or nine days until a 20-minim dose has been reached; then persist with this quantity until the symptoms warrant a diminution of the amount. He has frequently used the highest dose for four and five months at a time before decreasing it, with the most satisfactory results. The chronic cases do not, as a rule, require so large a dose, or to have it so rapidly increased. In his average chronic cases the patients use 12 minims three times a day, beginning with 2 minims, increasing by 2 minims every six days to 8 minims, then every second week to 12 minims, according to the effect. During the first week or ten days, he remarks, there are troublesome eructations of gas flavoured with creosote, but he has not seen a single instance where this did not entirely subside after the creosote had corrected the fermentation caused by old indigestion.]

Creosote may be administered in a number of ways. It may be given in milk; it may be given in pill, in mixture, or in solution; it is frequently given in alcoholic liquor; it may be given in the keratin-coated pill described; it may be given in a capsule with cod-liver oil or in cod-liver-oil emulsion. The dose to begin with is from 1 to 3 minims, and this may gradually be increased to doses even of a drachm, though, as has been said, no advantage seems to result from this heroic dosing. If digestive disturbance occurs or if signs of poisoning appear, the use of the remedy is to be stopped at once. For hypodermic use creosote may be mixed with an equal quantity of oil of sweet almonds, and 10 minims of this may be injected deep in the tissues of the back, though some prefer a solution less concentrated, Perom using a 10-per-cent. solution in oil of sweet almonds and injecting 80 minims twice a day. Intratracheal injections of a 5-per-cent. solution in recently boiled olive oil have also been used, the impression being that the drug so introduced would reach and act upon the diseased lungs more perfectly. Of this there is

no proof, and the dangers of the practice are self-evident.

[Dr. Walter F. Chappell, of New York (*N. Y. Med. Jour.*, March 30, 1895), regards creosote as quite as efficient in *laryngeal tuberculosis* as it is in the pulmonary form of tubercular disease, but thinks it should be used both internally and topically. He prefers an oily solution, especially the following:

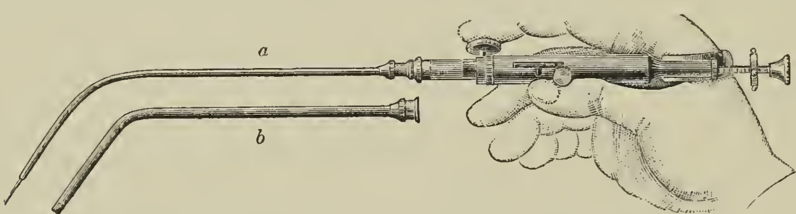
Beechwood creosote, } each. 2 fl. drachms;
Oil of wintergreen, }
Hydrocarbon oil.......... 1 fl. drachm;
Castor oil................ 3 fl. drachms.

The oil of wintergreen and castor oil, he says, should first be mixed together, then the hydrocarbon oil added, and lastly the creosote. Sterilizing the solution by dry heat gives it a much clearer appearance. This oily solution of creosote is clear, very fluid and non-irritating, of pleasant odour and taste, and may be used as a spray, or applied by the laryngeal applicator or as a submucous injection. Topical application alone may be relied on for the successful relief of the symptoms of primary tubercular deposits with infiltration and hypertrophy of the mucous membrane, provided the temperature is not high and the general condition is good. If, on the other hand, the evening temperature is high and the case seemingly progressing to active ulceration, a few submucous injections should be used as adjuncts to local treatment. The cough, laryngeal soreness, and moderate dysphagia of primary cases are quickly relieved by sprays of creosote, but resolution of their infiltrations and hypertrophies is not so rapid. In several of Dr. Chappell's patients the laryngeal distress was relieved after a few applications, but the infiltration continued for months.

The interior of the larynx should be thoroughly cleansed before any treatment is undertaken. Applications may be made by means of down sprays, of the laryngeal syringe, or by absorbent cotton on an applicator. The latter occasionally produces an undesirable amount of coughing. An 8- or a 10-per-cent. solution of cocaine saccharinate is carefully applied to the larynx, this preparation being preferable, in Dr. Chappell's opinion, to the hydrochloride, as it does not produce so much gagging. After the cocaine has had time to produce moderate anæsthesia, a spray of creosote (2 drachms to the ounce) is used. After the spray the pyriform sinuses may be filled with creosote solution, and also some of it allowed to drop into the trachea through the opening of a gum-elastic tip which is drawn over the cannula of Dr. Chappell's automatic syringe. This keeps the laryngeal surfaces bathed in creosote for a considerable period, and the patient should, if possible, be kept perfectly quiet and not allowed to talk or swallow for half an hour afterward. The stronger solution of creosote may be used every third or fourth day and the weaker ones every day or so, depending entirely on the amount of stimulation it produces. He has seen the laryngeal membrane become very red and considerably swollen from too frequent applications. In the ulcerative stages of laryngeal tuberculosis, sprays of a drachm of creosote to the ounce may be used daily with advantage; but if there is no ulcerative process a personal experience of each case must decide the frequency of the applications. A slight burning sensation follows the application of creosote solutions, but it only lasts a few minutes. The disagreeable taste is pretty effectually covered by the wintergreen oil.

In tubercular laryngitis with ulcerations, says Dr. Chappell, both topical applications and submucous injections should be employed. They hasten the separation of sloughing tissue, stimulate healthy granulation, and at the same time arrest progressive ulceration. The injection should be as superficial as possible, as the primary tubercular deposit is immediately beneath the epithelial layer. Weak solutions of cocaine may be sufficient in some cases, but complete anæsthesia is usually necessary, and he has found 20-per-cent. solutions to be the most satisfactory. They should be administered on an applicator, although it might be safe to employ the spray if the physician was well acquainted with his patient.

In making the submucous injection a long needle with a laryngeal curve may be used with any hypodermic syringe; but there are some drawbacks to this, as the movement of the hand in pushing down the piston is apt to make the patient gag, and conceals from view the point we wish to inject. To obviate this he has had an automatic syringe made which allows the operator to disengage the piston with his thumb and still keep the point of the syringe in view in the mirror. The shank of the needle is a hollow tube about six inches long, which may be given suitable curves for laryngeal work. The needle is about half an inch in length, and corresponds to the large-



CHAPPELL'S AUTOMATIC LARYNGEAL SYRINGE.
a, Laryngeal needle for submucous injection. *b*, Laryngeal cannula, with gum-elastic tip and cover, for injections into the larynx and trachea.

sized hypodermic needle, with the opening close to the point. The depth to which the needle is to be inserted is regulated by a small piece of solid-rubber ligature which is drawn over the needle and may be shortened or lengthened accordingly. The rubber casing on the needle makes it easy and safe to employ pressure, and, owing to its suction, the rubber clings to the mucous membrane and prevents the creosote solution from welling up around the needle after the injection. The barrel of the syringe is partly of glass and partly of metal; the latter contains a spiral spring which is attached to the piston, and a longitudinal opening on the side of the barrel is notched to receive the catch of the spring. The piston goes the entire length of the syringe, and is graduated and furnished with a set screw to regulate the number of drops injected. The solution for injection may be warmed or not. The glass barrel should be filled and the piston catch pushed into the top notch of the metal barrel. The laryngeal needle, being already sterilized, is screwed on to the syringe and the piston dropped to the second notch of the barrel, thus filling the needle. After regulating the set screw for 1 drop (which is the amount usually employed), the syringe is ready for use. It should be passed into the larynx with the right hand, under the guidance of the laryngeal mirror held in the left. When the point of the needle has punctured the mucous membrane, the catch of the spring is dislodged with the thumb, without changing the position of the hand, and the piston springs down as far as the set screw and makes the injection. If possible, the needle should be held in position for a few moments. Little pain or reaction follows the injection of oily solutions, but pure creosote causes a burning sensation and considerable soreness, which lasts a variable time. Much depends on the locality of the injection; the posterior surface of the arytænoids seems to be specially sensitive. There is little or no hæmorrhage after the needle is removed, and on the following day the mucous membrane is more tense and possibly somewhat redder. This condition subsides in the course of a few days, leaving the tissues in a wrinkled condition, as if the mucous membrane was too large for the subjacent parts. This is most noticeable around the arytænoids. Careful judgment is required to determine how often the injections should be given, but as a rule it should be once in five or six days. If ulceration is proceeding rapidly, one injection may be given daily until three or four have been administered. After several injections, it is well to wait for a time and see if the circle of resolution will not spread from the point of injection to the neighbouring tissues.

The ventricular bands usually require superficial and deep injections, the former to reach the deposits in the bands, and the latter the ventricles of the larynx. The interarytænoid space should be treated from below upward, otherwise it would be impossible to obtain a good view after the first injection. Very superficial puncture should be made in the mucous membrane covering the arytænoids, as it is an easy matter to start a perichondritis in this situation. A row of injections should first be made around the base of the arytænoid cartilages and gradually approach their tips. Tubercular infiltration of the epiglottis renders it so thick and firm that it is capable of bearing considerable pressure and is readily subjected to this treatment. A single row of injections may be made around the free border of the epiglottis about half an inch apart. The lingual surface of the epiglottis is very accessible for injection, but the laryngeal surface is not so easily reached. If the anæsthesia is complete the epiglottis may in some cases be pulled forward sufficiently by the shank of the needle for the injections to be made. If this can not be effected, the needle may be pushed through the cartilage from its lingual surface.

After the injections the larynx should be kept as clean as possible, and sprayed every day or so with the weaker solution of creosote.]

Intrapulmonary injections also have been given, the solution used being generally one of 3 per cent. of creosote in oil of sweet almonds. Of this, doses of 10 minims have been injected into the diseased area. Such a practice is dangerous in the extreme, and death certainly has resulted in one case. Creosote may be given by enema, dissolved in alcohol and water or made into an emulsion with oil. These enemata should be preceded by a cleansing injection, and the remedy be carefully and slowly introduced. For a while these injections may be well borne, but sooner or later irritation, intolerance, and even inflammation result and the practice has to be suspended. Of this practice it may again be said that it has no advantages, and creosote, if not tolerated by the stomach, is better withheld.

Creosote water, *aqua creosoti* (U. S. Ph.), consists of 10 parts of creosote and 990 of distilled water, agitated vigorously together and filtered. The dose is from 1 fl. drachm to ½ fl. oz. Creosote mixture, *mistura creasoti* (Br. Ph.), contains 1 part of creosote, 1 part of glacial acetic acid, 2 parts of spirit of juniper, 32 parts of syrup, and 480 parts of distilled water. The dose is from 1 to 2 fl. oz. Ointment of creosote, *unguentum creasoti* (Br. Ph.), contains 1 part of creosote and 8 parts of simple ointment. Inhalation of creosote, *vapor creasoti* (Br. Ph.), contains 12 minims of creosote and 8 fl. oz. of boiling water, and it is directed that the creosote and water shall be mixed in an apparatus so arranged that air may be made to pass through the solution and may afterward be inhaled.

Recently there has been employed the *carbonate of creosote*, or *creosotal*. This is a viscid, oily liquid, yellow in colour but without odour. It is obtained by the action of carbon dioxide upon creosote, and in the intestine is thought to be decomposed into its two components. It is insoluble in water, but soluble in alcohol. The dose for an adult is from 1 to 3 fl. drachms. It may be given in emulsion.

HENRY A. GRIFFIN.

CRESOL, CRESYLIC ACID, CRESYLOL.—The cresols, substitution compounds of benzene, have been recommended as antiseptics, but have not come into general favour. Cresol triiodide has been recommended in the treatment of certain skin diseases. (See Losophan.)

CRETA.—See Chalk.

CRISTALLINE.—This name has been given to a substitute for collodion made by dissolving gun-cotton in methyl alcohol. It has the advantage of drying less rapidly. It must not be confounded with *crystalline*, which is the same thing as aniline.

CROCCUS.—See Saffron.

CROTON-CHLORAL HYDRATE.—See Butyl-chloral hydrate and under Hypnotics.

CROTON OIL, *oleum tiglii* (U. S. Ph.), *oleum crotonis* (Br. Ph., Ger. Ph.), is a fixed oil which is expressed from the seeds of *Croton Tiglium*, a small tree indigenous to the East Indies. It is a transparent, yellow, viscid liquid of an acrid, oily taste. It contains stearic, palmitic, myristic, and lauric acids; a volatile acid, tiglinic acid, $C_5H_8O_2$; a liquid acid, crotonic acid, $C_4H_6O_2$; and crotonol, $C_{18}H_{28}O_4$.

Croton oil, rubbed on the skin, has been used to produce pustulation and moderate irritation in *chronic inflammation of joints* or *synovial membranes*, in *chronic bronchitis*, in *pleurisy*, and in *phthisis*. It has been applied to the spine in a liniment in *paralyses of functional origin* and in *hysteria*, to the head in *tubercular meningitis*, and to the nape of the neck in *chronic headache*. It has been applied along the course of the sciatic nerve in *sciatica*. Ure and others have recommended inoculation of the oil for the cure of *nævi*. It has been applied to the scalp to cure *tinea tonsurans*, a poultice being applied over the region as soon as the pustulation produced by the oil appears. It has proved useful as a counter-irritant in pulmonary complaints, such as *bronchitis*, etc. In some varieties of *oophoralgia* and *dysmenorrhœa* it is useful as a circumscribed application to the skin of the abdomen. When first applied to the skin it produces a burning sensation, which is followed by erythema and an eruption of small red papules which become pustules. The latter are surrounded by an areola and are accompanied with itching and burning; they may dry up or break.

Internally, the oil causes gastric warmth, sometimes followed by nausea and vomiting; there is irritation of the intestine, increased peristalsis is indicated by borborygmi occurring, and watery stools sometimes with tormina and tenesmus, result. It is administered for the relief of *obstinate constipation*, especially in the insane, to whom the dose of from $\frac{1}{4}$ to 1 drop may be given in milk, on a piece of bread, or on the tongue. In *lead colic* it is a most suitable purgative, rapidly emptying the overloaded intestine. Curling used it successfully to relieve *retention of urine* in persons of a robust habit. It has been used for the relief of *puerperal convulsions*, but aside from the advantage of rapidly evacuating the intestinal tract it is of no use in this disease. As a remedy in *dropsy* it has but a limited application. It is often an efficacious anthelminthic given in dose of 1 drop mixed with 1 fl. drachm of chloroform and 1 fl. oz. of glycerin, before breakfast. In *apoplexy*, when rapid evacuation of the bowels is desired, a drop of the oil may be placed on the back of the tongue. The oil has been recommended by some physicians in the treatment of *hydrocephalus*. The dose internally is from $\frac{1}{3}$ to 1 minim, in a pill, or placed on the tongue; if subsequent doses are required $\frac{1}{12}$ of a minim is sufficient.

The Br. Ph. prescribes a liniment of croton oil, *linimentum crotonis*, consisting of 2 fl. parts of this oil, with 7 fl. parts each of oil of cajuput and rectified spirit.

In case of poisoning with croton oil some demulcent fluid, like linseed tea, oatmeal tea, etc., should be administered at once after the stomach has been emptied of its contents by a stomach pump, or a hypodermic injection of apomorphine, or the administration of mustard and water. Its toxic effects vary; Mauvezin (*Gaz. d. hôp.*, 1869, xlii) reported the recovery of a six-year-old child that had taken 48 drops, while fatal poisoning has ensued when much smaller doses have been taken.

Samuel T. Armstrong.

CRYPTOPINE, $C_{21}H_{23}NO_6$, is an alkaloid found sparingly in opium. It is said to act like morphine in producing sleep, but to be four times as powerful, and, when used in large doses, to dilate the pupil.

CUBEB, *cubeba* (U. S. Ph., Br. Ph.), *cubebæ* (Ger. Ph.).—This is the dried, unripe fruit of *Cubeba officinalis*, or *Piper Cubeba*, a climbing perennial plant indigenous to the East Indies and cultivated on the plantations of Java and Sumatra. It has an aromatic, pungent, camphoraceous taste and a strong, spicy odour. Its important constituents are a volatile or essential oil and a composite resin. The volatile oil is a pale-yellow or colourless liquid, soluble in alcohol and separable into cubebin, a liquid oil, and cubebene, a heavy camphoraceous substance. The resin is composed of cubebic acid, cubebin, and an amorphous resin. Cubebic acid, according to Bernatzik, is faintly acid and nearly tasteless, and dissolves in concentrated sulphuric acid, producing a purple-violet colour. If a little water is added the colour changes to red, and if more is added the colour disappears. Cubebin is a neutral, crystallizable, tasteless, and odourless substance, according to some authorities. According to others it is odorous, and forms the greater portion of the sediment which is deposited from the oleo-resin on standing.

The active principles are the volatile oil and the cubebic acid, both of which are contained in the oleo-resin, *oleoresina cubebæ* (U. S. Ph., Br. Ph.).

Cubeb was introduced into Europe during the Middle Ages by Arabian physicians, who used it centuries ago in genito-urinary troubles, but it seems to have been used as a spice rather than as a medicine up to the beginning of the

present century, when its medicinal employment was revived by English medical officers in India.

It is an aromatic stomachic and a stimulant diuretic in small and medium doses, but in large ones it deranges the digestion and may act as a gastro-intestinal irritant. Its constituents are eliminated by the bronchial mucous membrane, the skin, and the kidneys, increasing the bronchial mucus, the perspiration, and the urine, although according to Binet the pulmonary elimination is either insignificant or practically wanting. Sometimes it causes an urticarial or vesicular cutaneous eruption. This rash, according to Hill and Cooper, differs from that produced by copaiba in that it is more of an orange-red colour and more distinctly papular and each spot is smaller. It appears rather on the trunk than on the limbs. Cubeb increases the action of the heart and that of the vascular system, stimulates the venereal appetite, and promotes the menstrual discharge.

Its chief value is in *affections of the bladder* and *urethra*, and depends upon its antiseptic powers, which tend to partially sterilize the urine and so exert a beneficial influence upon the suppurating mucous membrane. It is mainly used in the treatment of *gonorrhœa*, and may be given with good effect during the acute stage. It is usually found to be advantageous to combine it with copaiba, which has a similar range of action but is more likely to derange the digestion. It is also of value in *chronic cystitis*, *prostatorrhœa*, *leucorrhœa*, *cystorrhœa*, and *functional irritability of the bladder*—in short, in nearly all inflammations of the mucous membranes of the genito-urinary tract. In *chronic catarrh of the rectum*, in *pseudo-membranous enteritis*, and in *atonic dyspepsia* its use has been found of service. Excellent results frequently follow its employment in *chronic bronchitis*, and it is highly recommended as useful in the later stages of *influenza* and also in *diphtheria*. Temporary relief may be obtained in *acute nasal catarrh*, with a swollen mucous membrane, by smoking cigarettes made of cubeb or by the insufflation of the powdered cubeb upon the swollen membrane after secretion is well established.

Troches containing cubeb are good for *chronic irritability of the fauces, pharynx*, and *air-passages*, and are much used by singers and public speakers to relieve and prevent hoarseness.

It must be borne in mind that some persons are very susceptible to the action of cubeb, and that nausea, hæmorrhoids, hæmaturia, and severe headache may result from its use.

[The dose of cubeb in powder is from ½ to 2 drachms. That of the oleo-resin is from 5 to 30 minims. The troches, *trochisci cubebæ* (U. S. Ph.), contain, each, 0·6 of a grain of the oleo-resin. The fluid extract, *extractum cubebæ fluidum* (U. S. Ph.), may be given in doses of from 30 to 60 minims. The dose of the tincture, *tinctura cubebæ* (U. S. Ph., Br. Ph.), is from ½ to 2 fl. drachms. That of the oil, *oleum cubebæ* (U. S. Ph., Br. Ph.), is from 5 to 20 minims. The *extractum cubebarum* of the Ger. Ph. is a mixture of an ethereal and an alcoholic extract; the dose is from 5 to 15 grains.]—Matthias Lanckton Foster.

CUCUMBER OINTMENT, an unofficial ointment made from the common cucumber, is employed as a soothing application for *cutaneous irritation*. Individual pharmacists follow processes of their own in making it; hence it is well to use the ointment furnished by a maker having the reputation of producing it of good quality.

CUCURBITA.—See Pepo.

CUPPING.—This therapeutical procedure consists in the establishment of a vacuum over a limited area of the surface of the body, which gives rise to a local congestion depending for its degree upon the vascularity of the part operated upon, the size and number of the cups, the time they are kept in position, and the completeness of the vacuum. The apparatus employed may consist of a small bell-like glass in which a small piece of paper or similar substance soaked in alcohol is placed; this, being ignited, rarefies the larger part of the air, and when the cup is applied to the surface the flame is instantly extinguished. As the cup and its contents cool a more or less complete vacuum is established, provided care has been taken to adjust the edges of the cup closely to the surface. By an expert operator the burning paper may be removed from the cup before its application, but in less skilful hands it is rather better to allow it to remain. Moderately thin filter paper is the best to use, as it is bibulous and leaves but little ash. Often the operation can be performed by rinsing out the interior of the cup with a few drops of alcohol, which may be easily ignited, and applying it before the flame is extinguished. When either of these plans is adopted the spilling of any alcohol upon the person is to be avoided, as also the use of more than enough, for it is apt to ignite, and, while not likely to give rise to any untoward results, is pretty sure to arouse the apprehensions of the patient; moreover, if any remains unconsumed, it will vaporize and destroy the vacuum. When cupping glasses are not at hand, any similar glass, china, or metallic vessel may be used, provided the edges are not too thin or rough, so as to produce excoriations. Equally suitable as the ordinary glasses are cups provided with a small syringe-like attachment for exhausting the air, or those arranged for connection with an aspirator. There are also those made of rubber of such consistence as to admit of their application in a compressed state, from which they readily resume their cup-shape when the compression is stopped. In an emergency an ordinary breast pump can be used, but it is not entirely satisfactory, on account of the small area affected. When any agent except heat is used the edges of the glass may be smeared with some unctuous body, which will in a measure prevent the entrance of air beneath the cup. In removing cupping glasses it is well to admit air by gently manipulating them or introducing a probe or match stick beneath the edge. Of course when one is provided with mechanical means for exhaust-

ing the air the reversal of the operation is all that is necessary. No limit can be set as to the time a cup should be allowed to remain in place; almost the only thing to be avoided is the causing of ecchymosis, which may occur in persons whose blood-vessels have weak walls. Cups may be applied to almost any portion of the body having a reasonably plane surface, but as a rule they are not often used except upon the temples, the nape of the neck, the back, the chest, and the loins. When a cup is removed, after having exerted its influence sufficiently to cause a determination of the blood to the surface, and the surface scarified or punctured and the cup reapplied, the procedure is known as wet cupping and may be substituted for the various methods of bloodletting, to the article on which subject the reader is referred for the indications, etc., for their employment. Wet cupping is somewhat more painful than leeching, but in some cases is preferable, as the amount of blood withdrawn can be more accurately determined. Usually the amount of blood removed by the application of one cup will not be so large as is desired, and in such cases a second should be in readiness to apply as soon as the first contains sufficient to destroy the vacuum, which will occur quickly or slowly according as the scarification has been extensive or slight. The bleeding from leech-bites may be promoted by the application of cups when considerable quantities of blood are to be taken.

It has been suggested that in the case of *bites by venomous* or *rabid animals* a cup applied over the wound may withdraw the poison, and it is well to bear this in mind, in the absence of other means, but it is not to be wholly relied upon. The number of cups to be applied in any case will depend entirely upon the conditions present, but little harm is likely to result from an unnecessarily large number. While congested organs and tissues are beyond doubt temporarily relieved of the surplus of blood circulating in them, and thus the patient is tided over dangerous points, there is little or no doubt that the good results due to the use of dry cups depend largely upon their counter-irritant effect, which, however, is not so great as that of mustard and other rubefacients. As a rule, the *dyspnœa due to cardiac disease*, and the *pain and cough of acute pulmonary and pleural diseases* are temporarily relieved by dry cups applied to the chest and back. Acute *inflammation* and *congestion of the kidneys*, whether primary or secondary, are often benefited by a considerable number of dry cups applied over the lumbar region. *Intracranial congestions* and *inflammations* may be favourably affected by their application to the nape of the neck or over the mastoid region, according to the supposed situation of the trouble. In *spinal irritation* the good effects that sometimes follow their employment are probably due as much to their counter-irritant action as to anything else.

Russell H. Nevins.

CUPROHÆMOL.—Under the German name *Cuprohämolum* Klemptner has described an organic compound said to contain 2 per cent. of metallic copper and to be better borne by the stomach than any of the official preparations of copper. The dose, to be given in capsules or in pill form, is from $\frac{3}{20}$ to $\frac{3}{4}$ of a grain, three times a day. (*Therap. Wochenschr.*, March 3, 1895.)

CUPRUM.—See Copper.

CURARE, *curara, woorari, woorara, woorali*, or *urari*, is a poisonous extract of great potency prepared by natives of South America and said to be used by them as an arrow poison. Its exact origin and nature are uncertain, for, though it is believed to be derived largely from varieties of *Strychnos*, other plants are used in its preparation, and animal poisons, too, are said to be incorporated in it. No unity is found in the literature on the subject save only as to the derivation from varieties of *Strychnos*, and it must be frankly confessed that the drug is one of which little is known. This ignorance is amply explained by the obscure origin of the preparation, and is still more comprehensible from the undoubted fact that there are many varieties of curare, different not only in source but also in constituents, for the drug is not a simple extract, but a mixture of a number of ingredients. That curare is a mixture is stated by travellers who have witnessed its preparation, and from them we learn that the process of making it is first to make a decoction and then an extract of a number of plants, of which a species of *Strychnos* is one. In many respects, however, the descriptions of its preparation differ widely among themselves, and, as tribes and individuals no doubt prepare the drug from different materials and in different ways, the possible varieties of curare become infinite and the probable varieties many. Attempts at classification have been made, but the possibility of error can not be excluded. That of Planchon is often quoted (*Pharm. Jour. and Trans.*, xi, p. 491). He describes four varieties: 1. That from the upper Amazon, derived from *Strychnos castelnœana* and perhaps from *Strychnos yapurensis*. 2. That from the upper Orinoco, derived from *Strychnos Gubleri*. 3. That from British Guiana, derived from *Strychnos toxifera*, *Strychnos Schomburgkii*, and *Strychnos cogens*. 4. That from French Guiana, derived from *Strychnos Crevauxii*. No such distinction is possible with the curare of commerce, however important it may be in theory, and in the market curare is curare, sometimes of greater and sometimes of lesser strength. As sold here, the drug is dark brown or almost black in colour, resinous in appearance, and brittle. Its taste is bitter, and when powdered it has a strong odour. It comes usually in gourds or small earthenware jars into which it has been poured while yet liquid.

The active principle of curare is a crystallizable alkaloid called *curarine*. Though this has been found in the specimens examined, it is probable that a considerable alkaloidal variation exists among the varieties of curare, both in quality and in quantity. Curarine may be obtained in colourless crystals which are of an

intensely bitter taste. It is deliquescent and soluble in all proportions in water and in alcohol. It forms salts which are crystallizable and soluble, the nitrate, sulphate, acetate, and hydrochloride having been prepared. Its formula is probably $C_{18}H_{35}N$. With pure and concentrated sulphuric acid curarine produces a beautiful and lasting blue colour, and with strong nitric acid a purple. These reactions may be used as tests for the presence of the alkaloid in the fluids of poisoned animals, but the physiological test is to be preferred. Another alkaloid, called *curine*, has been found in some specimens of curare.

Applied to the unbroken skin, curare is not absorbed. Given by the mouth, it is absorbed very slowly—so slowly in fact that, owing to its rapidity of elimination, few symptoms may follow its administration in considerable doses, because of the small amount present in the blood at any one time. When it is introduced directly into the cellular tissue, however, absorption is very rapid and the constitutional effects soon appear. The effects on man were carefully studied by Voison and Liouville, and are as follows: From small doses there occur more rapid and more forcible heart action, increased frequency of respiration, slight elevation of temperature, and an increase of the amount of urine, which is light-coloured and contains glucose. From larger doses the first effect is a rigour with all its accompanying symptoms. This is soon followed by a considerable elevation of temperature and the symptoms of fever. There occur also loss of power in the legs and inco-ordination, which last but a short time, though weariness and weakness may remain for several hours. The fever, too, remains present, though gradually falling, even for several days. Sweating and increase of the urinary secretion are common, and stimulation of the lacrymal, nasal, and salivary secretions may be observed. Disturbances of vision with contraction or dilatation of the pupil occur. The mind remains clear. The action of curare to produce paralysis of motion is its most important power, and is due, as in the case of conium, to a paralysis of the terminal fibres of the motor nerves. From these the paralysis, after the administration of large doses, will extend to the motor-nerve trunks, to the sensory nerves, and in fact to all the nervous structures, if the animal experimented upon is kept alive sufficiently long by the performance of artificial respiration; otherwise it will die far earlier from asphyxia, the result of paralysis of the muscles of respiration, and paralysis other than of the motor-nerve endings will not have had time to occur. Upon the heart the action of curare is first to stimulate and later to cause its depression and paralysis. The blood-pressure, however, falls early from vaso-motor paralysis. The circulatory stimulation of curare is thought to be due to the curine, which is believed to be similar in action to digitalis, and to have no such action on the motor nerves as curarine has. Curare is said to be eliminated to some extent by the bowels, but mainly by the kidneys and as curarine. Elimination is usually rapid, but after large doses it may be complete only after twenty-four hours. The urine is apt to be increased by it, and glucose is generally present unless the dose has been very small. Why it produces glycosuria is unknown, but the explanation is thought to lie in an action on the liver. Since curare is eliminated in the urine as curarine, it is possible to poison animals by the administration of this urine, and it is said by some that unless the bladder is kept emptied in cases of poisoning, resorption from its mucosa may take place and thus the poisonous effect may be continued and accentuated. The theory of vesical absorption is in general not believed, however, but in poisoning by curare catheterism can do no harm and may possibly be of benefit. The treatment of curare poisoning includes the prompt ligation of an extremity into which it may have been injected if the case is seen at once, with the usual local treatment of a poisoned wound. Other than this, heat and stimulation should be employed, and above all things artificial respiration, for death threatens from paralysis of the muscles of respiration, and if the breathing can be artificially maintained until elimination has taken place recovery will probably ensue. As respiratory stimulants, strychnine and atropine may be given hypodermically.

Curare is a drug the main employment of which by us is for physiological experimentation, the "curarized frog" being often employed where peripheral motor paralysis is demanded. In medicine it has been little employed and should be less. Grave *convulsive conditions*, indeed, may demand its employment, and then a certain amount of therapeutic risk is necessary, but except for conditions of urgent necessity the drug is too little known, its preparations vary too much in strength, and it is altogether too dangerous to be recommended. Its applicability is to convulsive conditions such as *hydrophobia, tetanus, strychnine poisoning, epilepsy,* and *chorea*. It has been used in all these and occasionally with success, but it is in no sense curative in any of them, for it merely produces a peripheral paralysis which prevents the convulsive manifestations of a central irritation, but does not cure it. It is also said to have been used as an antiperiodic and as a stomachic, but for these purposes it is neither valuable nor allowable.

In giving curare, the first dose should always be small, and in using a new specimen the same caution should be observed or its strength should be tested on an animal, for the greatest variation exists in the strength of the preparations.

The hypodermic dose of curare is from $\frac{1}{20}$ to $\frac{1}{6}$ of a grain. The hypodermic dose of curarine is from $\frac{1}{200}$ to $\frac{1}{100}$ of a grain. These doses may be increased according to the result obtained, the physiological effects being shown by headache, dizziness, and lassitude. In grave convulsive conditions the doses will require a considerable but cautious increase.

Henry A. Griffin.

CURCUMA, *turmeric*, is the dried rhizome of the *Curcuma longa*, a plant that is indigenous to southern Asia. The China and Java

turmerics resemble each other and are said to be the best for medicinal purposes; the Madras and Malabar turmerics are similar; the Bengal turmeric differs somewhat in appearance from the varieties previously mentioned.

The drug yields by distillation with water about 1 per cent. of an essential oil called *curcumol*, and by another process a pale yellow aromatic oil, *turmerol*, has been obtained; neither of these has been used therapeutically. After distilling the oil a colouring matter, *curcumin*, may be obtained by exhausting the residue with benzene or ether. When recrystallized from alcohol, it has the formula $C_{14}H_{14}O_4$, and an alcoholic solution becomes brownish red on the addition of an alkali, and orange-coloured when boric acid is added.

It is employed as a condiment in India and China; it is used as a dye, and also as a test for alkalies. J. Shortt has recommended it as a prophylactic in *paludal fevers*, but it has little, if any, medicinal virtue, though it was once used as a stimulant and tonic.

SAMUEL T. ARMSTRONG.

CUSPARIA, *cuspariæ cortex* (Br. Ph.), *angustura*, is the dried bark of *Galipea Cusparia*. It is stomachic and tonic. In large doses it produces vomiting and purging. In tropical America it is reputed to be of value in the treatment of *diarrhœa* and *dysentery*. The dose of the powder is from 10 to 30 grains; that of the infusion, *infusum cuspariæ* (Br. Ph.), is from 1 to 2 fl. oz.

CUSSO (U. S. Ph., Br. Ph.), *flores koso* (Ger. Ph.), *kousso*, consists of the dried panicles of *Brayera anthelminthica*, an Abyssinian rosaceous tree. Cusso is used only as a remedy for *tapeworm*, and not often for that purpose, although it is very efficient. An infusion of the fresh flowers is the best preparation. The dose of the infusion, *infusum cusso* (Br. Ph.), is from 4 to 8 fl. oz.; that of the fluid extract, *extractum cusso fluidum* (U. S. Ph.), is from ½ to 1 fl. oz.

CUTIN.—Lusteck (*Aerztl. Rundschau*, 1895, v; *Am. Med.-surg. Bull.*, Sept. 1, 1895) has given this name to a soft material, invented by him, which is intended as a substitute for silk or catgut, and which may also be employed to prevent gauze from adhering to wounds. It is prepared from the gut of cattle by carefully removing the serous and mucous membranes from the muscular layer and digesting the latter in a 20-per-cent. solution of pepsin. The membrane swells and becomes gelatinized. It is then treated with trioxybenzoic acid and hydrogen peroxide, which harden the membrane. Antiseptics may, if desired, be added before the hardening process. Thus prepared, cutin is very soft, adheres smoothly to the wound, is capable of being absorbed, and may be sterilized by dry heat. Dr. Ziegler has employed it in numerous cases of transplantations with good results. He has also used this material instead of a drainage-tube, and, placed between the wound and iodoform gauze, to prevent the latter from sticking to the wound surface. The advantages which Dr. Ziegler alleges for cutin over silk are its much softer texture, and consequently its greater pliability, its power of being absorbed, and its property of being sterilizable.

CYANIDES.—See under CYANOGEN, and cf. HYDROCYANIC ACID.

CYANOGEN, CN_2, is a colourless gas of a strong and penetrating odour which resembles that of bitter almonds. It is inflammable, and burns with a purplish flame. It is prepared by heating mercuric cyanide, and is soluble in water and in alcohol. Cyanogen is exceedingly poisonous and is not itself employed in medicine.

Ethyl cyanide, *hydrocyanic ether*, *propionitrile* ($C_2H_5.CN$), is a colourless liquid of an ethereal odour made by the action of ethyl iodide on potassium cyanide in sealed tubes and at a temperature of 180° C. It is soluble in alcohol and in water. It is very poisonous, and its action and dose are the same as those of hydrocyanic acid.

Gold cyanide is a salt seldom used in this country, but by some it has been thought valuable in *scrofula* and *syphilis*. It is officinal in the Fr. Cod. It is likely to undergo decomposition, and hence should be kept in a dark place and freshly incorporated in a pill when required. The dose is $\frac{1}{15}$ of a grain, and this may be gradually increased until $\frac{1}{8}$ of a grain is reached. (See GOLD.)

Hydrogen cyanide.—See HYDROCYANIC ACID.

Mercuric cyanide, *hydrargyri cyanidum* (U. S. Ph.), *hydrargyrum cyanatum* (Ger. Ph.), $Hg(CN)_2$, occurs as white or colourless crystals which become darker on exposure to light. It is without odour, but of a metallic taste, and is soluble at 59° F. in 128 parts of water or 15 parts of alcohol. It is a violent poison. Its therapeutical employment is as a substitute for corrosive sublimate in the treatment of *syphilis*, and it possesses the advantage of being less irritating in its action. The hypodermic injection of from 25 to 30 drops of a 1-per-cent. solution has been practised by Prochorow with success in syphilis and, it is said, without local irritation, and Stellden has used a 1-to 10,000 solution as a gargle in *diphtheria*, combined with its internal administration. The dose, given internally, is from $\frac{1}{16}$ to $\frac{1}{8}$ of a grain. It should be kept in well-stoppered bottles.

Mercury and zinc cyanide is a double salt which has been recommended by Sir Joseph Lister as an antiseptic suitable for surgical use. The advantages stated for it are that it is not volatile, not irritating, and not sufficiently soluble to be easily washed from surgical dressings. Its disinfectant value is small, however, though it possesses some power to inhibit the activity of bacteria. From it there was formerly prepared a "cyanide gauze," which, however, scarcely seems to have been a potent dressing, for it was wetted with a 1-to-4,000 corrosive-sublimate solution previous to its application.

Potassium cyanide, *potassii cyanidum* (U. S. Ph., Br. Ph.), KCN, occurs as white, opaque, amorphous masses, or a white granular powder which is deliquescent in moist air and

has the odour of hydrocyanic acid. Its taste is sharp, and it is a violent poison; 5 grains have caused death in many cases. It is soluble at 59° F. in 2 parts of water. It is decomposed by boiling water and is but slightly soluble in alcohol. It is used in the preparation of *bismuthum purificatum* (Br. Ph.). Applied to the unbroken skin, it acts as an irritant and causes redness; its longer application produces vesication and even sloughing. Absorption, too, will follow its local application, its physiological effects becoming manifest and poisoning even being possible. These occurrences are especially pronounced if the skin at the site of application has been broken. Its uses in medicine are like those of diluted hydrocyanic acid. A solution of the strength of from 1 to 4 grains to 1 fl. oz. is valuable for the relief of *neuralgia* and severe *headache*, placed upon the painful area on a compress. Guthrie has highly recommended a solution of from 3 to 6 grains in 1 fl. oz. of distilled water to be dropped into the eye every other day for the removal of the *stains of the conjunctiva* which have been caused by silver nitrate, and the same staining of the hands may be removed by a solution of similar strength. For *pruritus vulvæ* a lotion composed of 15 grains of potassium cyanide and 8 fl. oz. of cherry-laurel water may be employed, and an ointment containing potassium cyanide, 6 grains to the ounce, is recommended to relieve the irritation of various *skin diseases*. In cases where the skin is broken these applications must be made with great caution. For internal administration the dose is $\frac{1}{8}$ of a grain, largely diluted with water, and the addition to this of an acid will result in the evolution of hydrocyanic acid, which otherwise would take place in the stomach. Potassium cyanide should be kept in well-stoppered bottles.

Potassium ferrocyanide, *potassii ferrocyanidum* (U. S. Ph., Br. Ph.), $K_4Fe(CN)_6.3HO$, yellow prussiate of potassium, occurs in large yellow crystals without odour, but of a saline taste. It is soluble at 59° F. in 4 parts of water, but insoluble in alcohol. It is not poisonous, even in large doses, and was formerly employed as an anthidrotic for the relief of *colliquative sweating*. At the present time its use is almost entirely pharmacal; with it are prepared diluted hydrocyanic acid, potassium cyanide, and silver cyanide. It should be kept in well-stoppered bottles.

Silver cyanide, *argenti cyanidum* (U. S. Ph.), is a white powder without odour or taste, which turns brown on exposure to light. It is insoluble in water and in alcohol, but is soluble in a solution of potassium cyanide. It is not employed in medicine, but is used in pharmacy to make hydrocyanic acid.

Zinc cyanide, *zinci cyanidum*, $ZnCy_2$, is a white powder said to be used considerably in Germany as a substitute for hydrocyanic acid. It has been given in *chorea*, *epilepsy*, *neuralgia*, and various forms of *abdominal pain*, and as an anthelminthic. Lashkevich has recommended it for the treatment of *cardiac neuroses*, giving from $\frac{1}{10}$ to $\frac{1}{5}$ of a grain three times a day. The dose usually is $\frac{1}{4}$ of a grain, which may be gradually increased until $1\frac{1}{2}$ grain is given. It is administered generally in a mixture. It is official in the Fr. Cod.

Zinc ferrocyanide, *zinci ferrocyanidum*, $Zn_2FeCy_6+3H_2O$, is a white powder used as a substitute for zinc cyanide. The dose is from 1 to 4 grains, in pill.

A marked similarity of action exists between the various cyanides and hydrocyanic acid, and like it they are all, save the ferrocyanides, poisons of the greatest intensity and violence. Their use must be attended with much caution; in case of poisoning the treatment is the same as in that due to hydrocyanic acid (see HYDROCYANIC ACID).—HENRY A. GRIFFIN.

CYANURETS.—Cyanides (see under CYANOGEN).

CYDONIUM.—The seeds of the fruit of *Cydonia vulgaris*, quince seeds. A decoction of quince seeds is used as a domestic remedy for conditions in which a demulcent application is desired. This decoction has been applied as a collyrium and as a demulcent in *skin diseases*, and given internally in *dysentery*. A decoction of quince, according to the historian Prescott, was formerly used in Spain as an antidote for *poisoned wounds* caused by arrows dipped in aconite.—SAMUEL T. ARMSTRONG.

CYPERUS ARTICULATUS. — This American tropical plant, jointed sedge, has been used as a tonic, antemetic, and anthelminthic. A non-official fluid extract is made, the dose of which is $\frac{1}{2}$ a fl. drachm.

CYPRIPEDIUM (U. S. Ph.).—The rhizome and roots of *Cypripedium pubescens* and *Cypripedium parviflorum*, ladies' slipper, an orchideous herb, are credited with medicinal virtues resembling those of valerian, but feebler. The fluid extract, *extractum cypripedii fluidum* (U. S. Ph.), may be given in doses of from $\frac{1}{2}$ to 1 fl. drachm. The plant contains a resin, *cypripedin*, which has been used as a narcotic for children in doses of from $\frac{2}{3}$ to 2 grains.

CYTISUS LABURNUM.—This genisteous plant has been employed as a nervous sedative. It contains an alkaloid, *cytisine*, $C_{20}H_{27}N_3O$, the nitrate and the hydrochloride of which have been given subcutaneously, in doses of from $\frac{1}{20}$ to $\frac{1}{12}$ of a grain, for the relief of vaso-paralytic *migraine*.

DAMIANA.—This drug consists of the leaves of *Turnera aphrodisiaca* and *Turnera diffusa*, two small, mint-like shrubs of the family *Turneraceæ*, indigenous to Mexico and Central America. The leaves of other allied plants, such as *Bigeloria veneta*, are still to some extent mingled with these to form the damiana of commerce, but to a lesser extent than formerly. The twigs, small branches, and flowers are to be found with the leaves as they appear in the market.

The odour of the entire plant is agreeable, resembling that of mint, and is due to the presence of a volatile oil. The taste is bitter. In addition to this volatile oil, damiana contains two resins, tannin, and an extractive,

but to which of these constituents it owes the peculiar qualities ascribed to it is unknown. Wonderful aphrodisiae powers are attributed to it by the Mexicans, who have used it for many years, and now it forms the principal ingredient of the various "manhood-restorers" widely advertised by charlatans, but the value of the drug is doubtful. It does probably exert some stimulant effect upon the sexual appetite and function, but not to any such degree as has been alleged. In its physiological action it is a stimulant diuretic and a general bitter tonic; on the digestive organs it acts as a carminative and slightly as a cholagogue, and, in larger doses, as a laxative or cathartic.

The main purpose for which damiana is employed is to aet as an aphrodisiac in cases of *functional impotence.* In such cases it should be combined with nux vomica, iron, and phosphorus, and particularly with proper hygienic treatment. It has also been employed with advantage in some forms of *cerebral exhaustion*, *general atony of the nervous system*, *nervous dyspepsia*, *neuralgia*, and *migraine.* Damiana is not official. An infusion is used in doses of 1 fl. drachm, an extract in doses of from 2 to 10 grains, and a fluid extract in doses of from 10 minims to 1 fl. drachm.

MATTHIAS LANCKTON FOSTER.

DATURA.—See STRAMONIUM.

DECOCTIONS, the *decocta* of the pharmacopœias, are preparations made by boiling one or more drugs in water, sometimes after more or less prolonged digestion. They are now little used in medicine, but occasionally Zittmann's decoetion, *decoctum sarsaparittæ compositum* (U. S. Ph., Ger. Ph.), *decoctum sarsæ compositum* (Br. Ph.), is employed in the treatment of advanced *syphilis.* Decoetions are bulky, usually of a nauseous taste, and unpleasant to the eye, and they decompose readily on account of the presence of gum, starch, albuminoids, etc., extracted from the substances from which they are made. They should be prepared in vessels lined with tin or poreelain or made of china, and during ebullition a cover must be employed, as otherwise when any of the constituents of the material used is volatile the efficiency of the preparation may be destroyed. The U. S. Ph. directs that all non-official decoctions shall be made with 50 grammes of the drug and enough water to make 1,000 c. c. of the finished product, unless the prescriber orders a different strength. The decoctions of the Br. Ph. are a trifle stronger, containing a little more than 6 per cent., and in the Austr. and Ger. Ph's the proportion varies from about 8 to 10 per cent. The U. S. Ph. has abandoned all these preparations save a decoction of cetraria and the compound decoction of sarsaparilla, and there are no very good reasons why these should have been retained. If possible, the comminuted, fresh drug, sliced or bruised, should be used, but when it is not attainable the dried one may be employed with about as good results, provided it has been reduced to a coarse powder. Almost any of the medicinal herbs, barks, or roots may be employed, provided they do not depend upon a volatile body for their virtues. As a rule, the dose of those prepared from the less active drugs may be from 1 to 2 fl. oz. In domestic medicines deeoctions, or teas, play an important part, more particularly in the treatment of colds and ephemeral fevers, eupatorium or boneset, salvia, dandelion roots, pennyroyal, sassafras, peppermint, and spearmint being the most commonly employed agents. Those made from eupatorium and dandelion roots possess some merit as bitter tonics, and are ordinarily given in doses of from 1 to 2 fl. oz., either hot or cold, according to the inclination of the patient. Those prepared from the other substances mentioned are usually administered as hot as possible, and, although consisting of little more than water flavoured with a volatile oil, they are more or less useful, as they are given in considerable quantities and immediately before going to bed to "break up a cold." It is probable, however, that an equal bulk of hot water would excite fully as free diaphoresis as they do. In small doses they are mildly carminative, and in the country are given freely to infants for the relief of colic. When unsweetened, they are fairly free from objection for this purpose.—RUSSELL H. NEVINS.

DELPHINIUM.—See STAPHISAGRIA.

DEMULCENTS.—These are substances that exert a soothing effect on irritated surfaces to which they are applied, rather by reason of their bland, mucilaginous physieal properties than on account of any real medicinal action.

DENTIFRICES.—Precisely defined, dentifriees are substances used as abrasives for the removal of deposits of foreign materials from the surfaces of the teeth. As commonly applied, the term includes all preparations, whether powders, soaps, pastes, or mouth washes, used for the attainment of a hygienic condition of the oral cavity.

A wider significance attaches to these agents of therapeusis, due to modifieation and development of the theories of oral pathology. Indefinite mixtures are replaced by definite prescriptions compounded with a view to correeting reeognised pathological states by means of accurately applied therapeutic agents.

The researches of Miller have demonstrated beyond a reasonable doubt that *dentat caries* is a disease of microbic origin, as are also several varieties of *stomatitis.*

The investigations of the same gentleman have shown a great number of specifically pathogenic organisms which find a most suitable soil for development in the human mouth. Briefly enumerated, these latter are the pyogenic cocci, the cocci of septicæmia, of pneumonia, and of actinomycosis, and several others. The pneumococcus has been found an almost constant attendant in alveolar abscess. The worse the hygienic condition of the oral cavity, the more flourishing are the colonies of the organisms.

In view of these facts, means for the destruction of the organisms is an important and

well-defined indication for therapeusis. As a hint to the importance of this matter, it may be stated that attacks of *influenza* have been aborted by the timely sterilization of the nasal and oral cavities. Also, some forms of *aphthous stomatitis* are curable by means of a hydrogen-dioxide spray, without further medication. The major purpose of the use of dentifrices is the prevention of *dental caries;* coupled with this is the æsthetic consideration of clean teeth. A brief review of the disease process (dental caries) will show clearly the therapeutics indicated.

Food *débris* collect upon the surfaces of and between the teeth. These deposits become the seat of lactic fermentation. One of the resulting substances, lactic acid, attacks and decalcifies the enamel with which it is in contact. Following the loss of an area of this tissue, the acid and organisms gain access to the tubules of the dentin. The acid destroys the matrix, and the organisms destroy the vital elements of the tissue. Succeeding this is invasion, inflammation, and gangrene of the dental pulp, which is usually followed after a variable period by abscess at the apex of the root, organisms developing and flourishing as they find a suitable soil.

Usually the first consideration in making or prescribing a dentifrice is to employ some substance possessing abrasive power enough to remove the deposits (the food supply of organisms), and not powerful enough to abrade the enamel. The second consideration is to find means for the destruction of the organisms. The third is that of neutralizing the acid product of the fermentation. The fourth is the correction of morbid conditions arising from the presence of deposits and ferments. The fifth is the production of a soil unfit for the development of organisms.

The first indication is usually met by the use of precipitated chalk. As it is mildly alkaline, it serves also to neutralize the acid. Mechanical means precede and co-operate with the chalk; quill toothpicks and floss silk remove the coarse deposits. Next, a soft toothbrush charged with the chalk is used in such a manner that the bristles are insinuated into interstices and the brushing is perpendicular, as if the person were endeavouring to brush the gums over the crowns of the teeth. When lateral brushing is done, particularly with stiff brushes, it tends to brush the gums away from the necks of the teeth and thus expose the cementum, a tissue more vulnerable than the enamel.

Powdered magnesia is to be preferred to chalk as an antacid; it is a bland and unirritating powder, although possessing less abrasive power than chalk, and particles which remain under the gum margin are not productive of irritation.

The milk of magnesia (Phillips's) is an excellent antacid preparation, particularly useful in cases of erosion.

For the destruction of the organisms, what are known as the non-toxic antiseptics are used as washes. Hydrogen dioxide, preferably 3-per-cent. pyrozone, fulfils the indication. Preparations of this substance should have any acid present neutralized before they are used as a mouth wash. A pinch of sodium peroxide serves this end.

Listerine, borine, and thymozone (preparations of thymol, eucalyptol, and boric acid) are effective and agreeable antiseptics for this purpose. They may be used freely.

Powdered charcoal should not be used as a dentifrice. It is composed of sharp, hard, and insoluble particles, which insinuate themselves between the gums and necks of the teeth and cause irritation.

Should a more decided abrasive than chalk be demanded, the pulverized interior of the os sepiæ may be used.

If the foregoing means are not sufficient to remove deposits from the teeth, any of them remaining should be removed by the dentist by the use of scalers. The operation of scaling and polishing should be done annually or semi-annually.

It is extremely probable that deposits of salivary calculi are due primarily to the action of lactic acid upon the fluids of the mouth containing mucin. The lactic acid coagulates the mucin, and in the meshes of the coagulum are entangled lime salts from the saliva and various adventitious substances. So the first step in preventing the formation of these deposits is eliminating lactic fermentation from the mouth. With the present food habits of man this is scarcely possible.

Any preparation which can effect the destruction of salivary calculi once formed must contain acid in an amount sufficient to decalcify the enamel.

If these deposits are permitted to remain, they cause the gradual loss of the teeth through their encroachment. They produce a chronic congestion of the soft tissues upon which they rest.

The following is a sample of the tooth powders in common use:

℞ Cretæ præp.,
Iridis florent. pulv....āā ℥j;
Oss. sepiæ pulv......... ℥ss.;
Ol. limonis, or
Ol. gaultheriæ, or } .... q. s. for flavouring and odour.
Ol. rosæ.
M.

Specific pathological conditions will require the modification of prescriptions used. This subject is, however, included under the caption of oral therapeutics general, and not dentifrices.

The correction of conditions arising from the action of micro-organisms will cover the sterilization and filling of cavities of decay, to restore lost tissue and prevent further ingress to the interiors of the teeth. About the teeth, after the removal of large collections of foreign materials, the underlying soft parts will be found to present more or less congestion. Usually applications of diluted tincture of iodine will be necessary as a preliminary to the use of a wash.

The furnishing of an unfit soil is the procurement of perfect hygienic conditions. This is an end difficult of attainment, but the con-

tinued regular use of dentifrices and antiseptic washes will do much. Viewing tooth powders commercially, they are a mixture of prepared chalk, powdered os sepiæ, some powdered orris root, a flavouring of some essential oil, a little colouring, and enough powdered sugar to render them agreeable to the taste.

Add soap and we have the tooth soap; make a mixture of the powder with honey and glycerin, and a tooth paste is the result.

The mouth washes of commerce are usually combinations of cologne water, astringent tinctures, sugar, and colouring and flavouring matters. One of the most widely advertised of all is a decoction or tincture of quillaia, the housekeeper's soap bark.

As therapeutic agents, but few of these have any value. Dentifrices and mouth washes should have a composition directed toward the correction of whatever morbid condition may be present, the constituents to be varied according to the needs.

In point of effectiveness, a 4-per-cent. solution of hydrogen peroxide is superior to any of the advertised mouth washes. The widest latitude is covered by a powder of magnesia, and this followed by a mouth wash of an antiseptic. Thymozone and listerine are of the proper type. The following, from Miller, is better than either, as the flavour and odour invite continued use:

℞ Acid. benzoic............ 3 parts;
Tinct. eucalypti.......... 15 "
Alcohol.................. 100 "
Ol. menth. pip.,
Saccharin......... ... āā q. s.

The saccharin, being an antifermentative, performs a double office.

Henry H. Burchard.

DEODORIZERS are agents which remove or lessen foul odours. It was formerly believed that these odours bore an important relation to infectious and poisonous matters, and therefore the deodorant drugs were employed under the impression that with the removal of the smell there also occurred a destruction of the poison supposed to be its accompaniment. The association of foul odours with pathogenic micro-organisms is now recognised as inconstant, and it is known that a foul smell in itself is no more indicative of the presence of disease than freedom from odour is a guarantee of safety. For these reasons deodorizers are employed at the present time merely for the æsthetic purpose of relieving the olfactory sense of disagreeable impressions, while the more important matter, the prevention and the destruction of morbific material, with which an ill smell may or may not be associated, is accomplished by the use of cleanliness, antiseptics, and disinfectants. Disinfection and antisepsis, then, have at the present time practically superseded deodorizing as sanitary procedures; their aim is radical, and in inhibiting or destroying the disease-producing material they remove the source from which a foul odour might proceed. All antiseptics and disinfectants may therefore indirectly act as deodorizers, while some few of them are direct deodorizers as well. Of this class chlorine, bromine, and iron sulphate are examples, as is the much-used chlorinated lime, which acts solely by virtue of the chlorine it evolves. This chemical destruction of foul emanations is necessary to constitute a true deodorant action, for the mere removal of an odour by absorption, as is accomplished by charcoal, can not be entitled to that distinction, any more than the substitution and covering up of an unpleasant by a pleasant odour, as is accomplished every day in the use of aromatic oils and their preparations.

In practice, deodorizing, or the removal of foul odours, may be accomplished in several ways. If the odour is due to the action of micro-organisms we may make use of any of the disinfectants which will destroy them, or of the antiseptics which prevent their activity, and with their death or the inhibition of their action the odour will cease. This is certainly the most radical method of all, for though, as has been said, foul odours are not necessarily indicative of disease-producing organisms, yet they are generally dependent upon microbic action of some kind, and germicides are therefore certainly indicated for their removal. This indication is doubly strong when we realize that, though the cause of the odour may not be the specific cause of a disease, yet the odour alone may in time cause ill health, a thing which over and over again has been seen from the action of the much-discussed sewer gas, which without producing a distinct and clinically characteristic disease may undoubtedly give rise to cachectic symptoms of gravity. To the removal of odours by antiseptics and disinfectants there is the objection that time is required for their action, and to meet this objection there may be employed such drugs as carbolic acid and iodoform, which, while active by virtue of antisepsis, at the same time have odours of their own which are substituted for the offensive one. This combination of disinfection or antisepsis with deodorizing, indeed, is oftener accomplished by the use of carbolic acid than by any other means, and this whether the odour is from a diseased part of the patient or from the refuse and other ill-smelling matters of dwellings, cesspools, and drains. And, since this use is so frequent, it must be emphasized that, though antiseptic, and even disinfectant, if used in sufficient strength, and therefore, it may be ultimately and indirectly deodorant, carbolic acid has no direct or chemical power as a deodorizer, as chlorine has, its immediate effect in removing an odour being due solely to a substitution of its own odour for that which it is desired to remove. If disinfection is not an object, charcoal may be used, for by it the odorous effluvia are absorbed and taken away; but if the cause of the smell is continuous in action, charcoal is merely palliative and upon its saturation the odour returns. Finally, we may employ those simply aromatic substances of which cologne water is an example. These again are but palliative (though if an aromatic oil itself is used there must be credited to it a slight antiseptic virtue) and suitable only for

æsthetic purposes where the odour is but slight and the cause easily removable, for in this case again the deodorizing action is apparent only, since it is due merely to substitution and is necessarily limited.

For ordinary domestic uses there is at times employed a solution of moderate strength, known as compound solution of zinc and iron, *liquor zinci et ferri compositus* (Nat. Form.), or as "deodorant solution." This contains 16 tr. oz. of zinc sulphate, 16 tr. oz. of iron sulphate, 20 grains of naphthol, 60 minims of oil of thyme, 120 minims of hypophosphorous acid, and enough water to make 5 pints. In cases where woven fabrics are to be deodorized, injury to them is prevented by the use of a modified "deodorant solution" in which the iron sulphate has been replaced by the same amount of aluminum sulphate and the hypophosphorous acid omitted.

HENRY A. GRIFFIN.

DEPILATORIES, though etymologically the term would imply any means for removing hairs, are more specifically such agents as remove the hair chemically. They were more in use formerly than now, and especially in Eastern countries, but are still largely, and often imprudently, used for cosmetic purposes. Inasmuch as none of them prevents the hair from growing again, while at the same time they all tend more or less to inflame and roughen the skin, besides rendering each renewed growth coarser than the last, they are objectionable remedies. Wherever for a cosmetic or other purpose it is desirable to remove superfluous hair, the method by electrolysis, which removes them permanently, is decidedly to be preferred.

The chemicals most commonly employed in depilatories are *tersulphide of arsenic*, *quicklime*, *sulphide of barium*, and *sulphide of calcium*. Most of the formulæ that have been recommended contain one or more of these substances. The "Rusma of the Turks" was composed of 1 part of orpiment, 10 parts of quicklime or chalk, and 10 parts of starch. Delacroix's *poudre subtile* consisted of 4 parts of orpiment, 30 of quicklime, and 60 of powdered gum. Another contains 1 part of orpiment, 12 parts of quicklime, 10 parts of jasmine powder, and 4 parts of powder of palm soap. When used, these powders are made into a paste with a little water, spread over the hairy surface, and allowed to remain for a few minutes or till the paste begins to dry, when it is washed off. The solution of calcium sulphide, or "Martin's depilatory," "is prepared from 2 parts of slaked lime and 3 parts of water by passing through the mixture hydrosulphuric acid as long as it is absorbed." It forms a soft mass, separating into two portions when standing, and they are mixed when it is to be used. If it is properly prepared, an application of from eight to ten minutes' duration is said to be sufficient for removing the hair. Réveil's mixture is composed of 5 drachms of calcium sulphide, 20 drops of essence of lemon, and 2½ drachms each of glycerite of starch and starch. Boudet's mixture consists of 3 parts of sodium sulphide and 10 each of quicklime and starch. Made into a paste with water, it is applied for a minute or two and then is removed, together with the hair, with a wooden knife. A strong solution of barium sulphide, made into a paste with starch, may be used in the same way. Duhring recommends the following:

℞ Barii sulphid . . . . ʒ ij;
Amyli,
Zinc. oxid. . . . . āā ʒ iij.
M.

℞ Sodii sulphidi . . . . ʒ ij;
Cretæ præp. . . . . ʒ vj.
M.

These powders are made into a paste and applied in the same way as the others.

EDWARD B. BRONSON.

DEPRESSANTS.—See CARDIAC STIMULANTS, TONICS, AND DEPRESSANTS.

DERIVATIVES are remedies which relieve *inflammation* and allied morbid processes of a part by exciting the sensory nerves of another part or by causing turgescence of the latter. Lotions, sinapisms, blisters, cautery, cupping, leeches, bleeding, drainage, cold, heat, poultices, fomentations, packs, and baths are the external derivatives which are now most used. The internal derivatives are now known either to be futile, like mercury for fever temperature, or to act in other ways, like the hydragogues and drastics. Derivatives are used to stimulate in depressed rather than exhausted states, and to reduce local inflammations and chronic serous accumulations which are not accompanied by high arterial or febrile excitement.

The microbe theory of the inflammation in infectious diseases has brought into prominence other names for the derivative measures. The facts, however, that the household remedies which are said to draw away a disease belong to this class, and that they relieve *deep pain* and palliate other symptoms, justify the established belief that irritation or congestion of one part may influence a disease in a deeper-seated or distant organ. Thus, it is difficult to blister the skin overlying a region of intense internal irritation; the swelling of the great toe relieves the disordered digestion of gout; parotiditis is relieved by an incipient orchitis; extensive burns of the skin cause duodenal ulcer; renal calculus may be followed by paraplegia; headache may result from acid gastritis; cerebral congestion may be reduced by purgatives; mental dulness or cold feet may result from the determination of blood to the digestive organs after a hearty meal; while the physiological relations of the uterus and the mammary glands, the sympathetic ophthalmia due to a diseased eye or tooth, the shoulder-pain of a diseased liver, and the relief of deep-seated pain by rubefacients would indicate, according to Wood, that the so-called trophic nerves, which preside over tissue nutrition, may be excited in a reflex way by peripheral irritation.

The theory of the cure of disease by *conversion* presumes that derivatives alter morbid

action by substituting a milder and more easily cured disease for the original malady, as in the clearing of a corneal opacity by an eye wash which produces ophthalmia. The term derivative has sometimes been limited to measures which set up an artificial disease in close proximity to the seat of the primary trouble, as in the relief of abdominal pain by a mustard plaster; while the term revulsive has been used for the cause of a secondary disease in a part remote from the region of the primary malady, as in the application of leeches and blisters to the feet for apoplexy. Though the systemic action excited by these agents had a marked and frequently beneficial effect upon the primary lesion, the heroic treatment proved very dangerous, and it is no longer believed that the secondary disease cures the first, but that the causes of the secondary disease have some related and reflex action upon the original trouble.

The useful action of derivatives was at one time explained by the now discarded theory of *humours* in the blood and lymph. The local disease was supposed to be cured by the removal of its peculiar humour to another part of the body or by its drainage from the surface. Hence vesicants, pustulants, and setons were vigorously employed until the body was found to be almost too weak to repair the treated part with new tissue. Thus rubefacients and diaphoretics were used to excess, while the digestion and absorption of food were almost destroyed by emetics, cholagogues, hydragogues, and drastics. There is still a widespread belief among the laity that spring medicines are needed to remove the winter's accumulation of evil humours.

The theory that the general circulation of the blood and lymph can be indirectly influenced through the irritation of the peripheral nerves was the basis of a treatment formerly much used for febrile inflammations, and even for systemic fevers, but experience has caused the severe derivatives to be now considered as contra-indicated in such cases, arterial tension and bodily temperature being dangerously increased by their use. In these fevers, nitrate of potassium was also given internally, in small doses, as it was believed to prevent the blood from coagulating by removing its tendency to form fibrin, and thus to favour a freer circulation, which would remove several of the injurious features of inflammatory fever. Small doses are now known not to have such an effect, while the larger doses will cause gastritis and other symptoms of poisoning. That derivatives may in a reflex manner affect local circulation, Brunton illustrates by a swollen finger, the painful vascular tension of which when held at the side is relieved by holding the finger above the head. Dipping the finger in cold water, binding a cold compress upon the arm, or otherwise contracting the arteries leading to the swelling, will lessen the tension of the vessels. A warm poultice on the finger will also give relief, the heat dilating the capillaries of the collateral circulation, thus diverting the blood current from the inflamed part. Cold, on the other hand, brings about a reflex contraction of the efferent arteries, so that less blood reaches the inflamed part. The fact that alterations similar to those caused by cold and heat in the finger may be produced on the circulation in internal organs in a reflex manner through the vaso-motor nervous system by derivatives may explain their use as remedial measures.

Because applications to the surface of the body affect nerves and vessels, and through them the nervous centres, the circulation, and the nutrition of the tissues, Bruce concludes that their action is very complex and still obscure. He holds that rubefacients and vesicants, by attracting blood and draining off plasma, will relieve the circulation of parts in immediate vascular connection with the area to which these derivatives are applied, while depressing to the same extent the general circulation, diminishing visceral congestion or inflammation, and relieving the heart. Vesicants and pustulants may relieve the blood and tissues of organized or other pathogenic poisons by producing a flow of plasma or pus. The local circulation and nutrition of the underlying parts may be modified by a simple reflex, the impression from the irritation of the cutaneous nerves starting back from their centre, efferent impulses along the vascular and trophic nerves of the underlying parts only. The irritation of the local nerves and vessels in a superficial normal part will also affect its regulating vaso-motor and trophic centres in the brain and spinal cord, and this disturbance may so influence an adjacent trophic centre as to cause through the latter a change in the nutrition of a distant abnormal part which is in a condition of inflammation, pain, unnatural activity, or overgrowth. Thus, diseased lungs or an impaired joint may be benefited by the alterative or derivative effect upon their nutrition produced by irritants applied to overlying, or even to remote parts.

The indications for the use of appropriate derivatives are believed by various authorities to be found in the following diseases: *Acute local inflammations without fever, acute cerebral* and *spinal meningitis, angina pectoris, apoplexy, inflammation of the vermiform appendix, arthritis deformans, articular neuroses, biliary calculi, bronchitis, bursitis, caisson disease, cerebral hæmorrhage, cerebro-spinal meningitis, cholera morbus, chronic spinal meningitis, croup, dyspnœa, emphysema, gastralgia, gout, headache, Hodgkin's disease, hyperæmia of the brain or spinal cord or of their meninges, hysteria, interstitial pneumonia, laryngitis, leucocythæmia, locomotor ataxia, lumbago, meningeal delirium, mumps, myelitis, nephritis, neuralgia, neuritis, epistaxis, pachymeningitis, pericarditis, peritonitis, pharyngitis, pleurisy, poliomyelitis anterior, progressive bulbar paralysis, renal calculi* or *colic, retro-nasal phlegmon, sciatica, shock, spasm, spermatorrhœa, spinal-cord diseases, spinal irritation, spleen diseases, stenosis of the trachea, syncope, synovitis, thrombosis of cerebral vessels, tuberculosis of the larynx, tubercular meningitis, tumours of the brain* or *spinal cord, vomiting,* and *yellow fever.*

The contra-indications to derivatives are fever and general arterial excitement, the injurious symptoms of which are increased; asthenia, or exhaustion of vital power, where the weakened system may not be able to react and repair the irritated and injured tissue; constitutional symptoms such as are found in general infections or in general dropsy; and when the diseased parts are very irritable organs, such as the eye, which is more apt to be irritated than the adjacent part to which the derivative is applied. Among the derivative measures which may be employed to lessen inflammation and related morbid processes are the following: Rubefacients, including hot water, mustard and its preparations, ammonia and its preparations, the confined vapour of alcohol, chloroform, or ether, volatile oils, especially camphor, menthol, thymol, and turpentine, iodine carefully applied, arnica, capsicum plaster, and pitch plaster; other local stimulants, such as cold water or air, mechanical friction, faradaic electricity, and the rapid evaporation of local refrigerants; vesicants, including cantharides, mezereum, glacial acetic acid, confined ammonia, iodine, mustard oil, and scalding water; pustulants, such as croton oil, tartar emetic, strong nitrate of silver, ipecac, and the nitric-acid issue, which is a paper disk saturated with nitric acid, to be placed over the præcordia in angina pectoris, the suppuration being excited by covering the blister with a frequently renewed disk of adhesive plaster; cautery, caustics, cupping, leeches, bleeding, and setons, which are severer measures; demulcents, which relieve tension, including poultices of bread, meal, and flaxseed, fatty emollients, moist warmth from bandages or purified cotton, fomentations, hot douches, and other local anodynes, such as belladonna plaster, opium plaster, galvanic electricity, water, vinegar, saline lotions, and anodyne liniments.

DERMATOL.—This is a trade name for bismuth subgallate, the process of making which has been patented in the United States by a foreign firm. It is a yellow, odourless, tasteless powder, insoluble in ordinary solvents. Topically applied, it is antiseptic, astringent, stimulant (sometimes irritating), and somewhat analgetic. It has been used satisfactorily as a substitute for iodoform, dusted on to wounds, etc., in the form of powder or applied in an ointment of the strength of from 10 to 20 per cent., or suspended in glycerin or collodion, to *suppurating surfaces, burns, excoriations*, and patches of *eczema*. Given internally, it has proved very effeacious in the treatment of various forms of *diarrhœa* and in that of *fermentative dyspepsia*. It may be given in daily amounts of from 30 to 90 grains; 30 grains every four hours have been given in severe diarrhœa.

DESICCANTS are agents that tend to promote drying of the surface, more particularly the cutaneous surface. The indication for such agents is afforded in many conditions of the skin in which an *excessive secretion* or *abundant exudation*, by causing maceration of the epidermis, renders it more vulnerable and hence more liable to inflammation. Certain remedies that control excessive secretion by acting on the perspiratory function, like the anthidrotics, or substances that diminish abnormal exudation from the surface by condensing the epidermic or epithelial cells, like, for example, certain astringent lotions, may become virtually desiccant agents. But technically desiccants differ from these in that they act solely upon the surface. They are essentially absorbent agents, though incidentally they may be more or less hygroscopic. For the most part they are powdery substances which are practically inert so far as any chemical or physiological action is concerned. They may be either mineral or vegetable, and include such substances as talcum, magnesia, zinc oxide, precipitated zinc oleate, zinc stearate, bismuth subnitrate, subcarbonate, or subgallate, prepared chalk, lycopodium, the starches of wheat, corn, or rice, Florentine orris root, and in general all the so-called "dusting" or "toilet powders." With regard to the last named, however, it is always important that their composition be known. Many of them contain lead, mercury, or other deleterious ingredients. Great care, moreover, is needed to have the powder used free from grit and very fine or what is commonly known as "impalpable." Many of them are apt to attract moisture, and so become lumpy or gritty. They are best preserved in good paper boxes kept in a dry place. Special care is required in the use of gypsum, which, when diluted with lycopodium, talcum, or some other simple and bland powder, forms an admirable desiccant for exuding surfaces. But because of its hygroscopic nature it is apt to cake on the surface unless used with care. It is a good plan with this as with other drying powders, when applied in folds of the skin or in joint flexures, to sew the powder into elongated bags of cheese cloth which are quilted across to prevent its shifting and are then pressed well down upon the surface which it is desired to protect and keep dry. Among the desiccants might also be included certain drying ointments, such, for example, as Lassar's paste, which is composed of 1 part each of zinc oxide and powdered starch with 2 parts of vaseline. It is a question whether a drying oil like linseed oil should be included also. Though it tends decidedly to reduce a pathological discharge from the skin in superficial inflammations, it has a modifying effect as a reducing agent upon the epidermis which distinguishes it from most of the desiccants mentioned.—Edward B. Bronson.

DETERGENTS.—With the exception of soap and water, the cleansing agents are really antiseptics, and the reader is referred to the article on those drugs.

DIACHYLON.—This ancient name survives as one of the appellations of lead plaster, *emplastrum plumbi* (see under Lead), and of an ointment, *unguentum diachylon* (U. S. Ph., Ger. Ph.), composed of equal parts of lead plaster and olive oil. Diachylon ointment is much used as a soothing application in various

forms of *cutaneous irritation*, notably that produced by frictions with irritating substances for reducing the infiltration of the skin in *chronic eczema*, and in *bromidrosis*, especially of the feet (see ANTHIDROTICS, page 103).

DIALYZED PREPARATIONS are preparations obtained by the process of dialysis, which is based upon the law of the diffusibility of gases, or of liquids miscible with each other, even when separated from each other by porous diaphragms. "Porous" is to be taken here in a restricted sense, such membranes or diaphragms as permit a visible filtration being exempted. The law of the diffusion of gases and liquids was first clearly demonstrated by Graham. It is only the diffusibility of liquids which need be treated of here. Assuming that equal volumes of two aqueous solutions of some salt (for instance, sodium chloride) of different densities or percentages are placed in an apparatus so arranged that they are separated by a porous diaphragm (such as an animal membrane, parchment-paper, etc.), there will be two currents established, one of the stronger solution through the diaphragm into the weaker, and another of the weaker solution through the diaphragm into the stronger. If the two solutions are allowed to remain in the apparatus sufficiently long, they will eventually both contain the same percentage of the salt and remain at an equilibrium. If unequal volumes of two different solutions are made to pass, or to "dialyze" through a diaphragm into each other, the reaction will also cease when both are of the same percentage strength, but, as one of them is of larger volume than the other, the former will contain the larger portion of the salt. If, for instance, 1 pound of a 10-per-cent. solution of a salt (containing, therefore, 700 grains of the latter) is placed in a dialyzer (see below), and this floated upon 10 pounds of water, salt will pass through the diaphragm until the solutions on both sides of this are of the same density.

Assuming that there were no change of the weights of liquid on either side, there would finally be in the dialyzer 1 pound of a 0·909-per-cent. solution of the salt, and on the other side 10 pounds of a solution of the same strength. Of the 700 grains of the salt originally contained in the smaller volume, 636·3 grains will, therefore, have passed into the larger volume. If now the dialyzer were floated upon a fresh volume of water, the same process would be repeated—that is, of the 63·7 grains of the salt, 57·82 grains would pass into the water. Upon repeating the process several times more, the amount of salt would gradually become less and less. Theoretically the process is without limit, but in practice it is necessary to stop when the *useful* limit is reached, and this varies according to circumstances. Since the rate of diffusion is largely influenced by the temperature of the liquids or surrounding air, it is necessary to guard against sudden changes; and it is always advisable to select such conditions as will expedite the process. It should also be stated here that membranes differ very much in their penetrability as regards various liquids. If water is separated from alcohol by a rubber membrane, the alcohol will pass into the water, but the water will not pass to the other side. If a concentrated salt solution contained in a bladder is immersed in water, the latter will pass more rapidly into the water than the salt solution outward, and the bladder may thus be ruptured. Experience has shown that there are certain limits of concentration which it is best not to exceed.

The process of dialysis is carried out on a small scale by means of two vessels, one of which, the larger, or outer, is intended to be charged with water or other suitable liquid, and another smaller vessel, the bottom of which consists of a porous membrane (parchment-paper, etc.). The former vessel is known as an "exarysator," and the latter as a "dialyzer" or "dialysator." The water or other liquid into which the substances dialyze is often designated as "diffusate." The solution which is to be subjected to the process of dialysis is poured into the dialyzer to a height not exceeding about half an inch, and this vessel then floated upon the liquid in the larger vessel. Osmosis soon begins, and may be continued until equilibrium in the percentage of the dialyzed substances on both sides of the membrane is established. When the portion on the dialyzer is practically exhausted, a new portion of the original liquid may be subjected to treatment, and if the desired object admits of it, the several residues may be concentrated and further dialyzed.

There is a remarkable difference as regards the facility with which different substances will pass through such porous membranes. Chemical bodies of a definite composition and capable of crystallizing dialyze readily and more or less rapidly. Such bodies are designated as "crystalloids." Other bodies, particularly those of an amorphous character, dialyze only slowly or not at all. These are termed "colloids." As an example of the latter class may be mentioned albumin. This does not altogether fail to dialyze, but it dialyzes very slowly as compared with crystalloids.

The process of dialysis is employed in certain technical operations on the large scale, as, for instance, for the extraction of sugar from beets. It is used by the chemist or toxicologist for the separation of alkaloids, arsenious acid, and other "crystalloids" from complex mixtures. And it has been applied in the preparation of standardized liquid extracts of vegetable drugs containing active principles. Some ten years ago a class of preparations of this nature was put on the market under the name of *dialysates*. These were aqueous or hydro-alcoholic solutions of the dialyzed active principles adjusted to a definite strength. Their standardization was in most cases effected by means of Mayer's solution. They are no longer in use.

While in most cases that portion of a mixture or solution which passes through the membrane is the useful object of the process, there is one exception, so far as medicinal chemicals are concerned. This is *dialyzed iron*. In this

case it is the residue on the dialyzer that is wanted. When a solution of ferric chloride is subjected to dialysis, and the diffusate replaced by fresh water several times daily, there will finally remain on the dialyzer a liquid basic ferric chloride the chlorine of which no longer reacts with silver nitrate. Since it requires several weeks to accomplish this, and since a very large plant would be necessary to turn out enough product to supply the market, efforts have been made to obtain the same product in a simpler manner, and these efforts have been successful. The method now employed is as follows: 195 parts of a solution of ferric chloride, containing 5 per cent. of the latter, are gradually poured into a mixture of 25 parts of ammonia water (10 per cent.) and 320 parts of water. The resulting precipitate of ferric hydrate is completely washed, the excess of water pressed out, and the magma mixed with 3 parts of hydrochloric acid and set aside for three days, when it is slightly warmed to effect complete solution. Finally, the solution is mixed with water until it has the specific gravity of 1·050. It now contains nearly 3·5 per cent. of metallic iron. This preparation is official in the German Pharmacopœia under the name *liquor ferri oxychlorati*, and it is there especially mentioned that this preparation may be dispensed when *liquor ferri oxydati dialysati* is prescribed. Since all the "dialyzed iron" of the market is now made in the manner just described, the name "dialyzed iron" has become a misnomer, and yet is likely to remain in use.

Charles Rice.

DIAPHORETICS.—The skin performs two secretory functions—one, the secretion of sebaceous material, the other that of a watery fluid holding certain solid ingredients in solution. No drug of which we at present have knowledge has any influence to increase the sebaceous secretion, but the watery secretion, or perspiration, is very subject to stimulation and depression from both internal and external influences. All of the means employed to increase perspiration are included under the term diaphoretics.

Two purposes are fulfilled by perspiration: the elimination of certain excrementitious materials from the body, and the regulation of its temperature. In a condition of health the eliminated material consists mainly of chloride of sodium, some fatty acids, neutral fats, and ammonia, and it is doubtful if it can then be found to contain lactic acid and urea, although these are present in certain morbid conditions. The amount of perspiration varies from day to day not only on account of the fact that the kidneys and the skin act to a certain extent vicariously for each other, but also on account of the varying condition of the external heat. The higher the temperature of the surrounding atmosphere is, the more freely is the perspiration poured forth and evaporated from the surface of the body, and thus the heat of the body itself is regulated and equably maintained. It has been estimated by Helmholtz that seventy-seven and a half per cent. of the whole loss of heat from the body is through the skin, mainly by means of perspiration, partly through radiation and conduction.

Although there are many drugs which are more or less diaphoretic in their action, there are very few whose action is so peculiarly of this nature that they should be classed distinctively under this heading. Heat, both moist and dry, and pilocarpine, may be so classed, but the list of drugs employed must include those whose distinctive qualities insure their classification elsewhere, such as nicotine, alcohol, salts of antimony, ipecacuanha, salicylic acid and its salts, acetate and citrate of potassium, Dover's powder, guaiacum, sulphur, camphor, opium, mezereon, sarsaparilla, sassafras, serpentaria, senega, ether, sweet spirits of nitre, lobelia, cocaine, aconite, and veratrum viride. An account of each will be found elsewhere.

The Turkish and Russian baths are valuable mainly on account of the diaphoretic action of the hot air, or steam, and this action, when needed, may be obtained at home by means of very simple improvised apparatus. To give a hot-air bath, place the patient in bed naked, with a cradle over him to support the bed-clothing, and allow the air free access to the body. Cover well with blankets, tucking them in closely on all sides and around the neck, leaving the smallest possible aperture at a convenient place for the introduction of a tin tube beneath the clothes. This tube should pass downward beside the bed and the lower end should flare outward. Beneath this end of the tube place the flame of an alcohol lamp. A heated current of air will thus be constantly carried into the space about the patient's body, and the temperature will rise rapidly to a high degree. A vapour bath may be extemporized by seating the patient on a chair having beneath it a vessel of water kept boiling by means of an alcohol lamp and carefully enveloping all parts of the body as high as the neck with blankets. By either of these methods prompt and powerful diaphoresis may be induced.

Herb teas, hot lemonade, and hot, diluted alcoholic drinks are promptly diaphoretic, but are not powerful and their effect is short-lived. They are useful mainly to equalize the circulation after exposure to taking cold, and when they are used for this purpose the patient should adopt other means for maintaining the diaphoresis thus induced—such, for example, as wrapping the body in warm blankets.

The most powerful diaphoretic known is pilocarpine, the active principle of jaborandi. It is used in the form of the infusion or of the fluid extract of jaborandi as well as the nitrate and hydrochloride of the alkaloid pilocarpine, which may be given hypodermically. Whatever form of administration is chosen, the effect is about the same. In five or ten minutes a flush appears all over the body, beginning with the head and neck, the rapidity of the pulse increases, and the perspiration begins to flow away very copiously. It usually acts strongly as a sialagogue, and frequently there is induced an abundant secretion from the mucous membranes throughout the entire body. For the purpose of eliminating excrementitious materials from the body by means of the per-

spiration jaborandi is particularly effective. Although urea is excreted very slightly if at all by the sweat glands when the body is in a state of health, it may be eliminated thus to a considerable amount in renal diseases, and jaborandi induces this elimination more than any other agent.

The purposes for which diaphoretics may be employed are to increase the elimination from the body of excrementitious materials, to lower the temperature, to equalize the circulation and prevent localized congestions after exposure to taking cold, and to reduce *dropsical effusions.*

In *fevers* waste products are formed in increased amounts, and diaphoresis, when it can be induced, aids in their elimination while at the same time it tends to lower the temperature. To attain this purpose the wet pack and warm alcoholic and aromatic drinks are employed, as well as such drugs as tartar emetic, ipecacuanha, spirit of Mindererus, citrate of potassium, aconite, and veratrum viride. Perhaps the drug most commonly employed for this purpose is ipecacuanha, sometimes alone, but usually in combination with opium in the well-known Dover's powder. By giving this mixture we obtain the relaxing effect of ipecacuanha and the stimulating effect of opium upon the cutaneous circulation, and not infrequently inflammatory diseases are cut short by its timely administration. It may be remarked here in passing that the perspiration is the only secretion of the body which is increased by opium. The powerful action of jaborandi in determining the elimination of urea through the skin in renal troubles has been mentioned above. This drug is therefore very useful in the *uræmia* of *acute* and *puerperal nephritis* and, to a lesser degree, in the chronic forms of *Bright's disease.* Other diseases also seem to be benefited by the depurating action of certain diaphoretics. Thus *rheumatism* is often controlled by salicylic acid and its salts, which cause free diaphoresis, and it is quite possible that the elimination of the morbific cause from the body is determined through the perspiration by the action of this drug. This may also, perhaps, explain the beneficial action of guaiacum and sulphur in chronic rheumatism. Impaired function of the skin seems to have at least something to do with this disease.

To reduce *serous effusions* diaphoretics are sometimes very useful, particularly when these effusions are the result of acute disease. But when they are the consequences of organic changes in the kidneys, heart, or liver, they can be benefited only to a very limited degree. Small localized effusions, such as exist in *detachment of the retina,* seem to find in these means their most promising form of treatment. In detachment of the retina the treatment which at the present time is considered to afford the best chance for recovery is absolute rest in the recumbent posture with the eyes bandaged, with daily diaphoresis by means of pilocarpine and the hot-air bath. The fluid beneath the retina is sometimes absorbed, and the retina becomes reattached to the choroid, but too frequently little effect is produced.

Acute nephritis is the disease in which diaphoretics are ideally most indicated. In all their modes of action they combat that inflammation. They increase the elimination through the skin of urea and other excrementitious substances usually excreted by the kidneys, thus relieving those organs and protecting the nervous system from uræmic poisoning; they lower the temperature; they tend to equalize the circulation and draw away the superabundant blood from the congested or inflamed kidneys, and so to aid them to resume their normal functions; and they reduce the dropsical effusions caused by this disease. To do this work jaborandi or pilocarpine is, when not otherwise contra-indicated, the ideal diaphoretic.

It is probable that diaphoretics act mainly through the nervous system, though some, perhaps, act directly upon the superficial blood-vessels. The action through the nervous system may be centrally or peripherally upon the sweat centres in the spinal cord or medulla oblongata, upon the nerves themselves as they pass from these centres to the perspiratory glands, or upon the terminations of these nerves in the glands. Possibly the action may sometimes be upon the glandular cells themselves. Physiological observations have been made to distinguish those diaphoretics which act centrally from those which act peripherally, but we can not yet speak with certainty in regard to this matter. Some writers consider that pilocarpine acts upon the vaso-motor centres and so produces dilatation of the arterioles in the skin, while by others it is held that it acts upon the terminal filaments in the gland cells. It may be that it acts in both ways. The diaphoretic action of hot air and of warm applications is probably due to dilatation of the superficial vessels of the skin and the direct stimulation of the sweat glands by the greater supply of blood, as well as to a reflex influence upon the sweat centres. Certain nauseants, such as tartar emetic and ipecacuanha, produce a general relaxation, particularly of the cutaneous vessels, probably by their action on the vaso-motor centres or nerves, and so produce diaphoresis.

Matthias Lanckton Foster.

DIAPHTHERIN, *oxyquinaseptol,* is a yellowish-white crystalline substance, readily soluble in water and in alcohol, employed as an antiseptic and deodorizer. It is said not to be poisonous and, in a 1-per-cent. solution, not to coagulate albumin. In the antiseptic treatment of *wounds, ulcers, otorrhœa, ozæna,* etc., it has been employed in a solution of from $\frac{1}{10}$ to 1 per cent., and found very efficient. It causes no pain, or at most only a momentary burning. In the form of a 50-per-cent. ointment, it is said to act as a caustic without producing pain. It should not be used in conjunction with a corrosive-sublimate solution, for when it is it imparts a yellow stain to everything it touches. It is decomposed by alkalies.

DIAPHTHOL, or *quinaseptol*, an acid substance closely allied to diaphtherin, is a feeble germicide, but its action is increased by associating it with an alkali, thus forming a diaphtholate. Sodium diaphtholate, in a 2-per-cent. solution, is a convenient form of the drug. It is said to be practically non-poisonous and to be readily tolerated by the stomach and bowels. It is eliminated unchanged by the kidneys, and hence is expected to prove very useful as an antiseptic in *urinary* as well as *gastro-intestinal affections accompanied by fermentation;* reports of its use on the human subject have, however, not yet been published.

DIASTASE.—See under Malt.

DIBROMETHANE. — See Ethylene bromide.

DIBROMOGALLIC ACID.—See Gallobromol.

DICHLORACETIC ACID, $C_2H_2Cl_2O_2$, when pure a crystalline substance, but usually met with as a liquid, has decidedly caustic properties (see under Chloracetic acid).

DIELECTROLYSIS.—See under Electricity and cf. Coca and Cocaine.

DIETETIC TREATMENT. — Various special plans of diet have been devised for the purpose of aiding in the cure of disease. Of these the most generally useful is the milk diet. Its various applications are fully discussed in this article and in that on milk.

A Skim-milk Diet is employed when fat is not desired and when whole milk is not well tolerated. It is now less in vogue than it was before the introduction of peptonized milk. It still, however, has a useful place and sometimes enables a patient to take milk who otherwise could not do so.

The Buttermilk Cure was at one time popular. It has been used more especially for the treatment of *nephritis, diabetes*, and certain *gastric disorders*. Buttermilk is an excellent substitute for milk, as it contains nearly all the nutritious elements of that food except the fat. When well borne, it is useful in relieving the monotony of a milk diet. Owing to the formation of lactic acid and changes in the coagulating property of the casein, it is very digestible. Its thirst-relieving quality is great.

The Whey Cure originated in Germany. Whey is useful in *acute febrile diseases* and in conditions marked by *irritability of the stomach*, but, owing to the small amount of nourishment in it, it is not suitable for prolonged use.

The Grape Cure also originated in Germany, but has never become popular in this country. It has been used most successfully at certain health resorts where numerous other factors have undoubtedly been potent in securing the good results.

A Dry Diet has been employed in *diabetes* and *dropsy*, but has fallen into merited disuse in those diseases. The most beneficial effects from this form of diet are seen in *dilatation of the stomach*, especially that form due to the excessive use of beer and ice water.

A Meat Diet proves of extreme value when proteid alone is indicated. The following are formulas for the meat preparations in most frequent use:

Beef-tea.—A pound of lean beef is chopped fine and put into a pint of cold water, where it remains for two hours. It is then allowed to simmer on the stove for two hours at a temperature not exceeding 160° F. As the water boils out it should be renewed by the addition of cold water, so that a pint of beef-tea will represent a pound of beef. The beef is expressed and the tea is strained. A wine-glassful is the amount usually administered. Ten drops of dilute hydrochloric acid may be added at the outset to disintegrate the meat fibre more completely.

Mutton broth is made by placing a pound of lean mutton in 3 pints of cold water, and boiling gently until the meat is perfectly tender. The meat is expressed, the broth is strained into a basin, and the fat is removed when cold. It should be administered warm.

Beef-juice.—A pound of round steak is seasoned with salt and pepper and quickly broiled. The juice is then expressed with a meat-squeezer. When small quantities only are required, a lemon-squeezer will answer, but a meat-press designed for the purpose is necessary if large amounts are to be prepared. A pound of meat should furnish 7 oz. of juice. It should be received into a hot glass and served warm, but must not be over-heated.

Meat powder may be prepared by chopping boiled beef, drying it in the oven, and grinding it in a coffee mill. It is used in water, broth, or milk.

Diet in Disease.

Diet may be prescribed for two purposes. It may be given simply to maintain nutrition or with the additional aim of aiding in the cure of disease. These two elements are so mingled in many diseases that it is impossible to separate the subject of diet in disease from that of dietetic treatment. Both these subjects are therefore considered in the present article.

Acute Febrile Diseases.—The problem of maintaining nutrition during the course of *acute febrile disease* is important but often difficult. While there is excessive tissue waste, and hence an increased demand for food, the digestive power is greatly reduced. To add to the difficulty, the eliminative processes are very active, the discharge of urea often being enormous. There is an excessive consumption of the proteids of the body, and to a lesser extent of the fats. There is therefore a demand not only for proteids but for proteid-sparing elements. These latter elements, however, do not have so much effect in conserving proteids as they do in health. The diet in these cases should be so selected as to perform two functions. It should supply the place of the elements most wasted and should be easily digested and assimilated. As these various conditions of tissue waste, increased elimination, and impaired digestion are more pronounced during the height of the fever, the problem of diet is much more seri-

ous in diseases accompanied by continuous fever than in those having an intermitting rise of temperature. In the latter class food should be administered chiefly during the period of remission. The diet in the *continued fevers*, especially *typhoid*, is a matter of the most vital importance. Death results in a large proportion of cases from exhaustion. This tendency is to be overcome partially by stimulation, but far more by judicious nourishment. The preservation of life may depend upon rapid and easy assimilation of food. A diet should be selected, therefore, which requires the least mechanical aid for digestion. In typhoid fever, ulcerations of the intestinal tract render the judicious selection of food doubly necessary. During recent years it has been the almost universal practice to "feed fevers," but indiscriminate feeding without due regard to the character and quantity of food may do irreparable injury.

Milk is the most universally useful article of diet in these diseases. It must not be forgotten, however, that although it is a liquid outside of the body, it tends in the stomach to form into solid and indigestible masses. This is overcome to a certain degree by diluting it with water. Free dilution prevents the formation of a solid coagulum, but seriously diminishes the food value. In mild cases, when the fever is not high, simple diluting with lime water or a mineral water may be all that is required. The theory that nourishment should be given in these cases in small quantities and at short intervals is a good one, but it may be perverted. Food should not be given to adults at shorter intervals than two hours. When plain milk is not tolerated, it may be peptonized. If it is possible to administer completely peptonized milk, the danger of the formation of solid masses of casein is removed. Peptonized milk is, on the whole, the best article of diet in acute febrile conditions. When milk, plain or peptonized, can not be given, kumyss or matzoon may be tried. These are among the most valuable of the milk preparations at our command. In extremely irritable conditions of the stomach whey may be all that will be tolerated. It may be rendered more nutritious by adding the white of an egg thoroughly beaten. The amount of milk administered must depend entirely upon the digestive capacity of the patient. Two quarts can usually be taken by an adult in twenty-four hours, but the stomach should in no case be overtaxed.

Meat infusions, used under proper restrictions, are also valuable aliments. Beef-tea contains the stimulating salts of meat, but is almost wholly devoid of nutritive properties. In typhoid fever it is not infrequently seen in the stools apparently but little changed. While beef-tea is not suitable for exclusive use in continued fevers, if properly made it may prove a valuable adjuvant. An objection to the use of the animal broths is the fact that the patient quickly tires of them. Sufficient attention is not always devoted to rendering them palatable. There is no objection whatever to the addition of vegetables and aromatic herbs. The flavour of the broth may thus be changed materially, and its administration may be continued where the plain broth would become distasteful. A little turnip, parsnip, parsley, or celery may be boiled with the broth and strained out, or they may be placed in a bag in the broth while it is brewing. A piece of toast may also be added. A little celery salt materially improves the flavour and adds no labour to the preparation of the broth. During convalescence, when starch becomes permissible, it may be added to the broth in the form of arrowroot, rice, or barley, which should be thoroughly cooked so as to break every grain. This is especially necessary in the *convalescence of typhoid fever.*

There is a growing tendency to the use of the pulp of meat in continued fevers. Raw lean meat is scraped very fine and passed through a sieve. Half an ounce of this may be administered plain, with a little salt and pepper, or it may be mixed with a cup of clear broth. Many practitioners now make free use of this aliment in convalescence. Beef-juice is another meat preparation which sometimes proves of value, especially during convalescence.

Eggs are not commonly used in the course of serious febrile diseases. The white of egg beaten up in hot water and strained may sometimes be added to broth. When but little nourishment is taken, white of egg, well beaten, may be added to water and given as a beverage. During convalescenee eggs may be used freely. Of the various drinks used in these conditions cool water is the most generally appropriate. It should be given frequently in moderate quantities. Egg water, toast water, or flaxseed tea is sometimes acceptable to the patient. Barley water or rice water may also be used, to which sugar with a little lemon-juiee may be added if desired.

Convalescenee from a febrile disease is supposed to be established when the evening temperature does not rise above 100° F. After long-continued fevers it is a period of great importance as regards diet. There is a growing tendency to the early administration of meat, either raw or rare-cooked. In eertain eases the patient seems to come to a standstill in strength and general condition, and makes no progress while the liquid diet is continued. It is then important to place the patient on a solid diet as soon as possible. No definite rules can, however, be laid down. The transition from the liquid to the solid diet must sometimes be slow, and every advance step must be taken with caution. The peptonizing of the milk must be gradually reduced, or the beef tea must be thickened more and more with cereals. This is to be followed in sueeession with raw meat, white meat of fowl, roast potato, raw oysters, etc., the diet being made slowly more and more general.

Febrile Diseases of Children.—Two errors are common in the feeding of sick babies —the administration of too much food and that of too rich food. The digestive power is diminished by fever even more in children than in adults. Less food should be given in

twenty-four hours than in health, and it should be more diluted. Milk is frequently given to the child every ten or fifteen minutes, with the almost certain result of deranging the stomach and bowels. It often happens that when the critical period arrives the overburdened stomach refuses to do its work, and gastro-enteritis is added as a complication to the original disorder. The child should be fed every two hours, and a careful record should be kept of the exact amount of food taken and retained during each twenty-four hours. The chief reliance should be placed upon milk diluted according to the age of the child and peptonized if necessary. Next to milk in importance are beef-broth, mutton-broth, beef-juice, wine whey, and oatmeal or barley gruel. In *scarlet fever* milk is especially indicated.

Gastritis, Acute and Subacute.—In *acute gastritis* it is sometimes impossible to administer any food by the stomach. In severe cases rectal feeding should be resorted to. In less serious cases whey, egg water, or a meat essence may be given. Frequently a mixture of milk and lime water in equal parts causes less disturbance than any other food. The amount should be small, and it should be taken at short intervals. Thirst should be allayed by teaspoonful amounts of very hot water or by cracked ice. In subacute gastritis, peptonized milk, milk and lime water, or an animal broth should be relied upon during the first few days. As the disease subsides rare meat or powdered meat may be given. Eggs, custard, milk toast, or boiled rice may also be employed.

Dyspepsia due to *chronic gastritis* is frequently a very stubborn disease. In its management the general principle that a diseased organ should not be unnecessarily taxed should not be forgotten, neither should it be carried to an undue extreme. The principle that only that food should be given which is digested in the intestine is erroneous. Such foods are chiefly starches and fats. On their way to the intestine they must remain for a certain time in the stomach. As they are both prone to acid fermentation, they are certain, if given in large quantities, to cause gastric irritation. The most suitable food is that which is quickly and easily digested by the stomach itself. Milk is usually an excellent article of diet in these cases. Its use should not be insisted upon, however, if it is not well tolerated. Skim-milk sometimes acts especially well. Rare meat, eggs, condensed meat soups, beef-juice, dry toast, and well-cooked rice are all appropriate. Small amounts of food should be taken at short intervals in severe cases. The diet should not be unduly restricted, however, for long periods of time.

Functional Dyspepsia.—Disturbances of digestion unaccompanied by inflammatory changes are exceedingly common. They are due to a great variety of causes. Grief, worry, and anxiety; the eating of rich and indigestible food; eating at irregular hours and in excessive quantities; and the excessive use of alcohol, tea, and coffee are among the exciting causes of this condition. As the symptoms differ widely, so must the treatment. In no other condition can set rules of treatment be given with less propriety. Rich, indigestible food must be prohibited. Meals must be taken at regular hours. The quantity of food must not be excessive; it should be properly cooked; and should be eaten slowly and thoroughly masticated. Tea, coffee, and alcoholic drinks should be restricted. Each case must be treated on its merits and according to the conditions present. If the dyspepsia is due to anæmia, worry, or debility, it is far better to strive to raise the digestive power to the point of digesting wholesome food than to reduce the food to a low standard. This is not done, however, by indiscriminately forcing improper food upon a weakened stomach. Some patients require a milk diet or even peptonized food. By others, whose dyspepsia is atonic, a more stimulating diet is required. They do badly on a bland food like milk, but digest meat with considerable ease, especially if it is well seasoned. Although it is not wise always to lay down definite rules for these patients, it is, on the other hand, not best to rely too much on what they believe to be their experience. They are full of whims, and their inability to eat is to a large degree imaginary. It is even wise in such cases to advise a general diet and to lay down no rules whatever. The stricter the rules and the more the patient's attention is called to his stomach, the greater does the indigestion become. In cases in which the patient watches every symptom, and is inclined to take medicine in large quantities, the medicine should be stopped and his mind should be taken as far as possible from his stomach and given some better employment.

Dujardin-Beaumetz has attempted to classify these cases. Patients with an increased secretion of gastric juice do best on a vegetable diet, with an abundance of fruit and milk. Those with deficient secretion of gastric juice do better on the meat proteids, the amount being adapted to the capacity of the patient. Milk is permissible, and peptonized foods must sometimes be used. Wine is allowed. Those troubled with sympathetic affections, such as giddiness, should receive a bland and very digestible diet. It may consist of vegetables, fruits, farinaceous substances, and milk.

The use of well-cooked nutritious food, eaten slowly, in proper amounts, at regular and proper intervals, with judicious tonic treatment, and the removal as far as possible of mental disturbance, will do more to cure many of these cases than a rigidly restricted diet.

Ulcer of the Stomach.—Few diseases show the results of dietetic treatment more decidedly than gastric ulcer. Articles of diet should not be selected for this condition which are in themselves irritating, which tend to excite the acid secretions of the stomach, which cause undue distention and peristaltic action, which remain long in the stomach, and which tend to undergo fermentation rapidly. It is usually wise in beginning the treatment to employ rectal feeding for a few days. Small amounts of food may then be given by the stomach. The value of an exclusively milk diet has been proved beyond question. The milk should be

peptonized. If the patient objects to this, milk and lime water may be tolerated. Four ounces should be given every two hours. Whey, buttermilk, or matzoon may sometimes be taken when milk does not agree. In case of hæmorrhage the stomach should receive absolute rest for several days, nutritive enemata being resorted to. A milk diet should be thoroughly tested, but if for any reason milk is not well tolerated, scraped raw meat may be given alone or in a little broth. Beef-juice may also be employed. Alcohol is contra-indicated, but weak tea or coffee may be given. This diet should be continued for at least a week after the symptoms have disappeared, and the return to an ordinary diet should be gradual and cautious.

Cancer of the Stomach.—This condition should receive practically the same treatment as that advised for ulcer of the stomach. As the disease is chronic, the necessity of supplying nourishment is great. Nutritious food is therefore required which places the least possible work upon the gastric digestion. If the cancer is at the pylorus special attention should be given to selecting a food which is absorbed from the stomach. Peptonized milk is here especially indicated. In *cancer of the rectum* and *intestines* the same general rule should be observed of selecting a food which furnishes the minimum amount of residue. The exclusion of fats and starches is not so necessary as in cancer of the stomach. A meat diet, as advised for phthisis, and peptonized milk will prove most satisfactory. Attention to the diet will do much to mitigate the suffering of these unfortunates.

Acute Diarrhœa.—One important rule is to be observed in the treatment of diarrhœa—the avoidance of all food that leaves much undigested residue. Not only should a food which leaves but little residue be selected, but one which is digested chiefly in the stomach and is not prone to decomposition. All green vegetables, acid fruits, and rich dishes should be avoided. The starches and fats should be rejected, reliance being placed chiefly upon proteids. At the outset the amount of food should be reduced to the minimum, rice water, barley water, or toast water being relied upon during the first day or two. The diet should be confined to milk, kumyss, buttermilk, whey, or raw meat. After a few days milk is usually the most suitable article of diet. It should be either peptonized or diluted with lime water or mineral water. It is sometimes best to boil the milk. Skim-milk is especially indicated, as the fat, which is not digested in the stomach, is thus reduced to a very small amount. The return to solid food should be gradual and should be delayed if there is a tendency to relapses.

Chronic Diarrhœa.—Diarrrhœa due to chronic intestinal catarrh requires dietetic treatment. The diet should be of milk, koumiss, or matzoon, meat, and animal proteids. According to Dujardin-Beaumetz, milk will cure every form of chronic diarrhœa except the tubercular. It should be peptonized if the patient does not object; if he does, it should be diluted with an effervescent water or lime water. Buttermilk makes an agreeable change for some patients. Sometimes whey alone is tolerated. As in acute diarrhœa, skim-milk is especially applicable, and many cures have been effected by its use. Kumyss must also be credited with many cures, not only of actual diarrhœa but of *intestinal indigestion*. A meat diet is preferred by some. Animal broths are to be used only for short periods when the patient tires of other forms of diet. These plans of treatment are all rational, as they supply food which is digested in the stomach and leaves but little residue. Unlike what is true of acute diarrhœa, fresh fruit juices may frequently be taken with great advantage, especially grapes, peaches, and oranges. The fatty, starchy, and saccharine foods are to be avoided. As the condition improves, rare beef and mutton, white chicken meat, raw oysters, rare-boiled eggs, custards, and boiled rice may gradually be added to the diet.

If the disorder does not improve after a sufficiently prolonged trial of a carefully restricted diet, the patient should not be persistently subjected to the discomforts which must follow its continuance. He should be permitted to take a plain general diet in which starch, sugar, and fat are reduced to moderate proportions.

The Summer Diarrhœas of Children.—In the treatment of these disorders the dietetic management forms a very important feature. At the outset all food should be withheld for a time. Milk should not be given while the disease is active. Barley water, chicken broth, or toast water may be given during the first day or two. Marked constitutional symptoms are evidence of the absorption of ptomaines, which are derived from the decomposing proteids. These elements should therefore be avoided when this condition is present and when the stools are putrid and contain mucus and blood. Carbohydrates are to be avoided when there are much flatus and pain. Meat broths, meat-juice, and cream may usually be given with safety. One of the proprietary foods may sometimes be given, but it should not be continued after recovery is established. When the use of milk is resumed, it should be largely diluted at first, the strength being gradually increased. The important rules in these cases are to reduce the quantity of food to the lowest possible amount, to stop the use of milk entirely, and to make a change in the character of the food. The last rule is for the purpose of changing the character of the decomposition which is causing the diarrhœa. Unless vomiting is persistent, water should be administered freely.

Constipation.—Two errors are common in the treatment of constipation. The first is reliance on a single measure—a single article of diet, a single drug, or a single mechanical procedure. The second is the attempt to cure a continuous and persistent condition by intermitting and spasmodic treatment. No single article of diet is sufficient for the cure of constipation, and many chronic cases resist all efforts at cure by diet alone. As a general

rule, food should be avoided which leaves but little residue, such as eggs and meat. A dry diet also should be avoided. Some patients are perceptibly benefited by the free administration of water. This is especially true with infants. A general diet should be permitted, meat, eggs, and milk not being wholly excluded. The green fresh vegetables are especially indicated, as are also fruits. Figs and raisins also may prove of some service, as well as stewed prunes and baked apples. Spanish onions have an especially laxative effect. Oatmeal has long had a reputation as a laxative, but this effect is largely lost by thorough cooking. Syrup and molasses are decidedly laxative, and gingerbread and cake containing them are sometimes very effective. A large quantity of vegetable food is not advisable, especially in constipation due to atony of the bowels and abdominal walls. Masses of residue are prone to become impacted and cause serious disturbance. The constipation due to intestinal indigestion is sometimes relieved by a skim-milk or kumyss diet and by the grape cure. It should be understood that reliance upon any one of these articles is not advised. The diet for constipation should be a general and generous one, consisting largely of the foods here mentioned, some of which have inherent laxative properties, others of which prove laxative by leaving a large residue.

Constipation in infants and young children is frequently surprisingly relieved by the addition of cream to the diet. The stool of a healthy nursing infant contains from 20 to 40 per cent. of fat, which indicates that the food should contain much more fat than is absorbed. If the child is nursing, the mother should have outdoor exercise and should take meat and milk freely. The child should receive a few teaspoonfuls of cream, just before nursing, two or three times a day. If the child is artificially fed, decided improvement usually results from the addition of cream to the food.

Diabetes.—Regulation of the diet is the most important element in the successful treatment of diabetes. In some cases diet alone effects a cure; in others it aids materially and reduces the amount of sugar, but does not effect a complete or permanent cure; in still others it has little or no effect. Patients of the last class are usually young; the disease is active, and runs a rapid and fatal course. The most rational treatment consists in rigorously excluding all starches and sugars, at the same time replacing them as far as possible by other forms of food. This is not an absolute rule, however, for certain foods in which sugar-forming elements occur have been found by experience to be harmless, undoubtedly from the fact that these elements are not readily transformed into sugar. Certain food substances, like milk, have given rise to much discussion and difference of opinion. Although milk contains a considerable amount of sugar, its use may be permitted to most patients. Cream is perhaps preferable for some reasons. Tyson advocates an exclusively milk diet, and has effected many cures in the early stages by this means. The experience of most practitioners will coincide with this. He recommends skim-milk because it is more readily digested than plain milk. Peptonizing removes this difficulty and furnishes a much more nutritious diet. Bread must be rigorously excluded from the diet of the diabetic. Several substitutes for ordinary bread have been proposed; gluten, bran, and almond flour are the most frequently employed. They all contain more or less starch and are not safe in serious cases. They are, moreover, very unpalatable to many. Those who must for any reason have starch may obtain it in the least harmful form in baked potatoes. It is a matter of the utmost difficulty to hold some of these diabetic patients for long periods of time to a closely restricted diet. It is sometimes wise to yield a point and allow some of the less harmful articles when the digestion becomes impaired and the appetite fails. Indigestion and dyspepsia should be carefully guarded against. Palatability is far more important when the diet is closely restricted than when there is a larger range for selection. Mr. and Mrs. Poole, in their little work *Cookery for the Diabetic*, have done much toward diminishing the irksomeness imposed upon these sufferers by such a diet. The use of saccharin has rendered diabetic diet far more endurable. Among the articles which are upon the border line may be mentioned cabbage, cauliflower, carrots, turnips, string beans, strawberries, raspberries, currants, and oranges.

The following articles are in most cases *permissible:*

Soup without flour, rice, or vermicelli.

Fish—all kinds; also oysters, clams, crabs, and lobsters.

Meats—all kinds except liver.

Game and poultry—all kinds.

Eggs in any form, without sugar or flour.

Butter, cheese, salt, pepper, vinegar, and pickles.

Vegetables—cress, lettuce, celery, spinach, mushrooms, olives, cucumbers, radishes, and onions.

Fruits—sour apples, plums, cherries, cranberries, gooseberries, and lemons.

Nuts—all except chestnuts.

Drinks—tea, coffee, milk in any form (kumyss, matzoon, buttermilk), cream, all mineral waters, acid wines.

The following articles should be *prohibited:*

Bread in every form, unless made of gluten, bran, or almond flour.

Vegetables—potatoes, beets, turnips, carrots, parsnips, peas, beans, tomatoes.

Cereals — rice, oatmeal, corn meal, sago, tapioca, arrowroot, wheat.

Sweet fruits — peaches, grapes, pears, oranges, bananas.

Drinks — chocolate, cocoa, malt liquors, sweet wines, cordials.

Pastry, puddings, ice cream, and honey.

Scurvy.—This is a constitutional disease due to a lack of fresh food. Fresh vegetables prevent its occurrence, and lime-juice is almost a specific for its cure. It is now extremely uncommon in adults. In infants, unfortunately,

owing to the increased use of proprietary foods and condensed milk, it is becoming not uncommon. These foods, even when administered with a small proportion of fresh milk, do not contain enough fresh element to always protect from scurvy. The treatment, even in extreme cases, is strictly dietetic. Fresh milk alone is sufficient for a cure. It should be properly diluted and adapted to the age and digestive capacity of the patient. Beef-juice is a valuable adjuvant. Some fresh vegetable substance is also of material aid. There is nothing better than orange-juice, which is taken with great eagerness by these little patients. These three elements—milk, beef-juice, and orange-juice—are all that are required to effect a cure of scurvy.

Rickets.—Rickets is a constitutional disease due to serious nutritive changes which affect the bones largely, but by no means exclusively. It is due, without doubt, to a variety of causes. The belief seems to be well founded that an excess of starch and a deficiency of fat in the food are very important factors in its production. They may occur alone or combined. The treatment is largely dietetic, but a complete discussion of it would involve the whole subject of infant feeding. In general terms, it may be said that these children should receive a diet rich in fat with a minimum amount of starch. The best fat for this purpose is cream, which should be given well diluted. It is best obtained by the use of "top milk," as described under the head of infant feeding. When breast-fed children are affected with rickets the breast milk is, almost without exception, found to be very poor in fat. If the character of the milk can not be improved, the child should be weaned or diluted cream should be given in addition to the breast feeding. This plan of treatment is far more satisfactory and rational than that of administering foods and drugs containing lime. Cod-liver oil, which has so long been used in this disease, should be regarded more as a food than as a medicine. Its use should always form a part of the treatment.

The same plan of treatment should be adopted in *scrofulosis* and the various *disorders resulting from impairment of nutrition.* The diet in such cases should contain a maximum amount of proteids and fats, with a minimum amount of sugars and starches.

Lithæmia and Gout.—These two conditions are regarded by most authorities as very closely allied. Da Costa especially considers lithæmia as modified gout, being the form in which gout particularly manifests itself in America. In no condition is there greater diversity of opinion regarding dietetic management. When one man secures excellent results from the use of the more digestible forms of albuminoids, and another rigorously prohibits all such food and obtains equally good results from a vegetable diet, and still another has cured patients by an entirely different plan, we are driven to the conclusion that these results do not depend materially upon the proximate principles included in the food. All observers are agreed upon one point—that the food must be digestible and adapted to the digestive power of the individual. No unvarying rule can be given for all cases. We are not yet sufficiently certain in our ideas on pathology to be very dogmatic. The old belief that nitrogenous food should be rigorously prohibited is not now generally accepted. Lithæmia is not due simply to an excess of nitrogen, but numerous other factors are known to exist. The lithæmic patient, according to A. H. Smith, is like a spendthrift who can not be cured by keeping money from him. He must be educated to better habits. As the spendthrift will pawn his clothes to get money, so the system will pawn the tissues, so to speak, to obtain nitrogen. It is not necessary largely to withhold nitrogenous food. A diet should be selected, after study of each case, which will be readily tolerated and assimilated. An excess of starch, fat, and sugar should be avoided, as by their fermentation they produce acids which seriously aggravate the disease. Fats, however, need not be wholly prohibited if they are properly digested. They are of value in diminishing the amount of carbohydrates needed. An excess of proteid should be avoided, that the system may not be clogged with nitrogen which is not required. It is better to give moderately of dark meat, according to Yeo, rather than to burden the digestive organs with an excessive quantity of white meat. Green vegetables, fresh fruits, white meat, fish, toasted bread, and meat or vegetable soups are especially appropriate articles of food in these cases. Opinions vary greatly as to the propriety of allowing milk. The question should be settled largely according to the case. Milk should not be given if it causes constipation or the so-called bilious condition. Water should be given freely, especially the alkaline mineral waters. The important point in the dietetic management is to secure a wholesome mixed diet, which will be readily digested and assimilated by the patient for whom it is designed.

Nephritis.—Although diet can not be relied upon for a curative effect in diseases of the kidney, dietetic management is of considerable importance. The proteids should be restricted and the diet made as digestible as possible. In *acute nephritis* an exclusive milk diet should be insisted upon. The skim-milk cure has been especially advocated, but it has no advantages over the use of peptonized milk. In *cirrhotic Bright's disease* less is to be expected from diet than in tubular disease. A general rule in all these conditions should be the administration of digestible food with an abundance of milk and the avoidance of an excess of proteids and of all rich and indigestible dishes.

Phthisis.—In the treatment of this disease diet is justly regarded as equal in importance to climate and more important than medicine. It is a striking fact that the symptoms abate as the weight increases. The power of digestion varies greatly with different patients, and each must be treated according to the conditions present. The carbohydrates are usually digested imperfectly, the foods in order of digestibility being proteids, fats, and carbo-

hydrates. Hence starchy, farinaceous, and saccharine foods are to be avoided. The bovine species furnishes us with the foods best adapted to this disease—meat, milk, cream, and butter. Milk, except in those cases in which it is found to be badly tolerated, should form the basis of the diet. If it can not be taken plain, it should be peptonized or diluted with lime water. Peptonized milk is a most valuable agent when the digestion is impaired. kumyss and matzoon also prove of the greatest utility. Their use makes a change possible when the patient tires of milk or when the stomach rejects it. Every means should be taken to render milk digestible, and every preparation should be employed before its use is finally abandoned.

Meat may be used in a variety of ways. Rare beefsteak may be given in the ordinary way. It is frequently given in the form of meat balls. The pulp of round steak is scraped away with a fork, leaving the fibre behind. This is rolled into small balls and broiled and served hot. So called Hamburg steak, without onion, is an excellent form of meat. Considerable amounts of fat can thus be given without detection by the patient. Meat may also be given raw. It is best scraped and placed between very thin layers of bread, salt and pepper having been freely added. This is an excellent method of giving meat. It is especially useful as a change when the patient has tired of it in other forms. Beef-juice is a most valuable meat preparation. According to Dr. H. P. Loomis, the juice of thoroughly squeezed beef is the best preparation of meat for use in phthisis, and the trouble in preparing it is repaid by the marked improvement in the patient. Meat powders are also useful in some cases. That of Debove (see ALIMENTATION, page 43) is especially designed for forced feeding in phthisis. It may be used in soups, broth, or milk.

Butter and cream may be given freely, the latter being more digestible if diluted with water or milk. It must at first be used with caution, as it does not agree with all stomachs. Cod-liver oil should be classed as a food, rather than as a medicine.

The phthisical patient should receive six meals a day. At the regular meals he may eat as much as he can properly digest. The diet may consist of soup, fish, chicken, eggs, oatmeal, and a few fresh vegetables, but meat and milk should constitute the most important part of the meal. Not more than half a pint of milk should be taken at a time, but this amount, if possible, should be taken at each of the three regular meals. Between these meals and at bedtime or on waking in the morning a light luncheon should be taken consisting of milk, kumyss, beef-juice, or raw-beef sandwich. Perfect rest for half an hour before meals will frequently do much to aid the digestion. It is wise to begin the regulation of the diet as soon as a diagnosis of phthisis is made. In some cases digestive disturbance does not occur for many months, and a general diet may be taken with impunity. It is better, however, even in these cases, to advise a diet consisting largely of meat and milk, and to restrict the use of starches. There are intervals in the course of many cases in which the digestion improves and causes but little trouble. At such times it is not wise to hold the patient to a strict diet. In other cases, and at intervals in most cases, the stomach becomes intolerant of almost everything. A diet consisting of milk, whey, meat, and hot water will then sometimes accomplish much. Monotony should be avoided as far as possible, and whenever it is practicable the range of diet should be extended.

Obesity.—It has been demonstrated that fat is not simply stored in the system from the fat in the food. It is formed to a large extent from the other elements, even from the proteids. Growing appreciation of this fact has considerably modified the plans of treatment adopted for obesity. Three plans have been popular: that of Banting, that of Ebstein, and that of Oertel. Banting allowed 27 oz. of solid food at the most, 16 oz. being animal. He limited the fluids to 35 oz. and bread to 2 oz. Starch, sugar, and fat he strictly excluded. The chief error in this diet was the exclusion of fats. It is true that it will reduce flesh, but not more effectively than that of Oertel, and it is dangerous when long continued. Ebstein allows fats, in the belief that they have but little effect in producing fat in the system. Their use also decidedly lessens the desire for other food, an important feature where a diminished amount of food is to be prescribed. He allows $3\frac{1}{2}$ oz. of bread and excludes other carbohydrates. The diet of Oertel is the most rational. It is based on the fact demonstrated by Voit that a person will lose flesh upon a diet consisting of $4\frac{1}{2}$ oz. of albuminates, $1\frac{2}{5}$ oz. of fats, and $5\frac{1}{3}$ oz. of carbohydrates. An important feature in cases of extreme obesity is the tendency to involvement of the heart muscle, thus weakening the circulation and seriously impairing the general strength. To avoid the danger of increasing this tendency the diet should be more general than that of Banting. Oertel therefore advises outdoor exercise, a diet consisting largely of proteids, and limitation of fluid. He permits the use of from 4 to 6 oz. of bread daily, and 12 oz. of tea, coffee, or milk, 12 oz. of wine, and from 8 to 16 oz. of water. Some authorities, such as Sée, do not object to a much larger quantity of water. The difference between these three diets is shown by the following table:

	Albuminates.	Fats.	Carbohydrates.
Banting	3 oz.	$\frac{1}{8}$ oz.	$2\frac{3}{4}$ oz.
Ebstein.	$3\frac{1}{2}$ oz.	3 oz.	$1\frac{3}{4}$ oz.
Oertel	$5\frac{1}{2}$ to 6 oz.	1 to $1\frac{1}{4}$ oz.	$2\frac{1}{2}$ to $3\frac{1}{2}$ oz.

The exclusive use of meat and hot water for several weeks is effective for the reduction of fat, but is rarely to be advised. The following diet is permitted by Oertel:

Morning.—Tea or coffee, 6 oz.; bread, 3 oz.

Noon.—Soup, 3 to 4 oz.; roast or boiled beef, veal, game, or poultry, 7 to 8 oz.; a light vegetable or salad; a little fish; bread or farinaceous pudding, 1 to 3 oz.; fresh fruit, 3 to

6 oz. In hot weather 6 oz. of light wine may be taken.

Afternoon.—Tea or coffee, 6 oz. with 6 oz. of water at the most; 1 oz. of bread occasionally.

Evening.—One or two soft-boiled eggs; bread, 1 oz.; a little cheese occasionally; salad or fruit; wine, from 6 to 8 oz. with from 4 to 5 oz. of water.—Floyd M. Crandall.

DIETHYLENEDIAMINE.—See Piperazine.

DIGITALEIN, DIGITALIN.—See under Digitalis.

DIGITALIS (U. S. Ph.), *digitalis folia* (Br. Ph.), *folia digitalis* (Ger. Ph.)—The leaves of *Digitalis purpurea*, or purple foxglove, a scrophulariaceous plant indigenous to the western part of southern and central Europe, where it grows wild in sandy soil and at the edges of woods. In this country it is cultivated in private gardens for its beautiful flowers, and, principally by the Shakers, for the drug market. The seeds contain the active principles in greater proportion than the leaves, but they are never used in medicine. The leaves should be collected from plants of the second year's growth, and, according to the *British Pharmacopœia*, they should be "collected from the wild indigenous plant when about two thirds of the flowers are expanded." Much of the digitalis found in market in this country is of poor quality, partly, perhaps, on account of adulteration with leaves of the mullein and inula, but largely on account of either deterioration through cultivation or carelessness in gathering and drying the leaves. It is uncertain to what degree cultivation causes deterioration in the medicinal qualities of the plant, though it probably has this effect to some extent, but it is certain that when the leaves are imperfectly dried decomposition sets in, which destroys the active principles and may result in new and poisonous ones.

The introduction of this drug into modern practice is due to Withering, who investigated its therapeutic powers about 1776–'79, although it was described and given the name of digitalis by Fuchs about the middle of the sixteenth century. A treatise on foxglove was published in 1597 by Gerard, and soon after this Parkinson recommended its use externally for scrofulous sores and internally for the "falling sickness." It had a place in the *London Pharmacopœia* of 1721, and also, perhaps, in earlier editions as far back as 1650, but was dropped in 1746.

Considerable attention has been paid to the determination of the active principle of this drug, and widely different substances have been named *digitalin* at various times. The Orfila prize was awarded in 1871 to Nativelle for the discovery of what was then supposed to be the active principle and was called by this name. This digitalin, which was not long afterward demonstrated to be a complex body and not to produce the characteristic action of digitalis, occurs in tufts of light, white crystalline needles, is very bitter, and is soluble in alcohol and in chloroform, but not in water. It consists mainly of what is now known as *digitoxin*, and more nearly represents a pure active principle of digitalis than any other digitalin which is now on the market.

Homolle's or Quevenne's digitalin, which is much used in France, occurs in an amorphous, yellowish-white powder, or in small scales, very bitter and irritating to the nostrils, though without odour. A digitalin closely resembling, if not identical with, this was formerly official in the *United States Pharmacopœia*, but was omitted in 1880.

Nothing bearing the name of digitalin should be prescribed with the expectation of obtaining the peculiar action of digitalis, which is probably due not to any one of its active principles, but to combinations of several. Schmiedeberg's analysis of digitalis is the one usually followed at the present time, although a definite decision in regard to its constituents can hardly be said to have yet been obtained. According to this analysis, digitalis contains five active principles—viz., digitalin, digitalein, digitoxin, digitonin, and digitin. These are all non-nitrogenous and, with the exception of digitin, are glucosides. Digitalis contains no alkaloids.

Of these principles *digitalin* seems more nearly than any of the others to represent digitalis. It is insoluble in water, but soluble in alcohol and in chloroform, and forms a large part of the amorphous digitalin of commerce. Although this digitalin has been chemically isolated, it has not been put on the market. [Numerous recent experiments in the administration of crystallized digitalin to dogs have led M. François-Franck to the conclusion that it is not prudent to give it to human beings in daily amounts exceeding 0·015 of a grain (*Bull. de l'Acad. de méd.*, July 2, 1895; *Lyon méd.*, July 21, 1895).]

Digitalein is soluble in both water and alcohol, and can be given hypodermically when occasion demands. The dose for this purpose is given as $\frac{1}{100}$ of a grain.

Digitoxin is the most active principle. It is insoluble in water and only sparingly soluble in alcohol. It can be found at times deposited as a sediment in the alcoholic preparations of the leaf.

These three are supposed to be the active cardiac stimulant principles of the drug. They are antagonized in that action by the fourth principle, *digitonin*, which appears to be both chemically and physiologically closely related to, if not identical with, saponin, the active principle of senega, which acts as a cardiac depressant. It is insoluble in alcohol, but readily soluble in water, and is probably the principle upon which the diuretic action of digitalis depends. *Digitin* is an inert substance. In addition to these five active principles, digitalis contains two acids, digitalic and antirrhinic, tannin, a volatile oil, colouring matter, starch, sugar, gum, and salts.

As may be inferred from this brief consideration of its chemical constituents, the physiological action of digitalis is complex. It is a cardiac and vascular stimulant, a diuretic, a hæmostatic, in toxic doses a paralyser, and to

some persons an emetic. Some writers consider it peculiarly adapted to light-complexioned persons with lax muscles and a sanguine, indolent temperament. It has a bitter taste, but no tonic action on the stomach. On the contrary, it is apt to have an irritating effect on mucous membranes, especially when they are already a little disturbed, and so will often cause indigestion, and, if its use is persisted in, vomiting and diarrhœa. Some stomachs are so susceptible to its action that its use is precluded by the severe vomiting induced.

As a cardiac stimulant it differs materially from ammonia and alcohol. It is a cardiac regulator, and a *dilated heart* remains permanently smaller while under the influence of the drug. Its action upon the heart partakes of a double character. By its effect upon the cardiac ganglia and the muscle itself it induces contraction and strengthens the systole; by its effect on the vagi it prolongs the diastole. The result of this double action is that the diastole of the heart is lengthened so that more blood is allowed to enter the ventricles, while the systole is made stronger so as to impart more vigour to the flow of blood in the arterial system, and at the same time a rapid and irregular action of the heart is slowed and steadied. Coincidently the arterial tension is raised, not only by the increased amount of blood thus thrown into the arteries, but also by a contraction of the arterioles throughout the body, probably induced by the action of the digitalin upon the vaso-motor centres.

Digitalis is said to stimulate the uterus also to contraction. It lessens the contractility of striped muscular tissue and causes lassitude and want of vigour. It depresses the venereal function and lessens the sexual appetite.

The action of digitalis upon the kidneys can not be said to be perfectly clear. Probably when a small dose is given, or during the first stage of action of a large dose, the renal arterioles contract in the same manner as those of the rest of the body, but they are the first to dilate, and then the drug acts as a diuretic. It is very likely that this dilatation is due to a special action of the digitonin upon the renal vessels. The blood-pressure in the glomeruli, together with the rapidity of the circulation, is increased, and so the kidneys are stimulated to heightened action. A serious objection to this theory is that it is very doubtful if digitalis has any diuretic power in health, and questionable in cases of disease not involving the heart, while it unquestionably has that power in cardiac disease accompanied by œdema and low arterial pressure. We are uncertain also as to the effect of digitalis upon the constituents of the urine, as some investigators maintain that by its action the elimination of urea is increased, others that it is diminished, and still others that it is first increased and then diminished.

Upon the respiration digitalis in medicinal doses has little or no effect. We do not know how it is itself eliminated from the body, but it is supposed to undergo oxidation in the tissues.

Sometimes it causes derangement of vision. Two forms of this derangement are described by Dr. Brunton: one a general mistiness, such as is seen before fainting, the other the appearance of a large, bright spot, sometimes annular in form, faintly showing the prismatic colours.

Upon the general nervous system digitalis produces no effect except as the result of toxic doses. The headache, vertigo, delirium, and convulsions which sometimes result from its use may be caused by a disturbance of the cerebral circulation, by gastric irritation, or perhaps by the volatile oil. Syncope may be due to heart failure from over-stimulation, especially if the patient suddenly sits up. Toxic doses reduce reflex action by exciting Setschenow's reflex inhibitory centres in the medulla oblongata, and induce both sensory and motor paralysis. At first the pulse is slow and full, then dicrotic, and the cardiac action tumultuous. The pulse may be full and slow when the patient is lying down, but irregular when he sits up. The pulse may become so feeble that it can with difficulty be felt at the wrist while the heart is at the same time throbbing wildly. As we proceed in the toxic stage we find reduced vascular tension, a quick, irregular, and feeble pulse, feeble and more rapid respiration, coma, convulsions, and death. Death results from cessation of the heart's action during systole, caused by exhaustion of the motor ganglia or by the tetanizing effect of the drug on the cardiac muscle.

In digitalis poisoning an emetic is useful if it can be given before the drug has had time to become absorbed, but after that time it is dangerous. The stomach should be washed out, the patient kept lying down, heat applied to the body, particularly the abdomen, and tea, coffee, and tannic acid given internally. Aconite is the physiological antidote, and should be administered in proper quantities. Inhalations of ammonia are useful. Compound tincture of cinchona, sulphate of iron, and tincture of chloride of iron have also been recommended.

The principal sphere of usefulness of digitalis is in *diseases of the mitral and tricuspid valves of the heart* associated with venous engorgement, œdema of the lungs and of the subcutaneous tissue, and interference with the action of the liver and kidneys. In *mitral insufficiency* it prolongs the diastole and permits the ventricle to receive a larger quantity of blood from the auricle; it then strengthens the systole, causes better approximation of the valvular flaps and so less regurgitation, and sends more blood into the arterial system. In *mitral stenosis* the lengthened diastole permits more blood to pass through the narrowed orifice and relieves the venous engorgement and the dependent symptoms. In *insufficiency* or *stenosis of the tricuspid valve* the action is the same as in the case of the mitral. But in *insufficiency* or *stenosis of the aortic valve* the effect of digitalis is generally injurious. The lengthened diastole favours an increase of the regurgitation in insufficiency, but when there is no compensatory hypertrophy, when the heart is weak and its action rapid, or when

there are other reasons which render it desirable to strengthen and regulate the systole, it may be used with good effect. So also in aortic stenosis when this condition has resulted in dilatation and mitral regurgitation with venous and pulmonary engorgement, or when the systole needs strengthening, it may be of good service. In these cases the dose given must be small and its effect carefully watched.

Digitalis is eminently the medicine for a dilated rather than for a weak heart. When compensatory hypertrophy fails and dilatation is beginning it slows and steadies the action of the heart, while it improves the condition of the cardiac walls by increasing the pressure on the coronary arteries and allowing them a longer time to become filled.

Dyspnœa or *asthma* due to pulmonary engorgement may usually be relieved by digitalis. Benefit may also be obtained from this drug in *palpitation of the heart* not dependent on indigestion, in functional weakness with *irritable heart*, and in *migraine* or *delirium tremens* associated with low arterial tension. Possibly the diverse action of digitalis in different cases of *acute mania* and *delirium tremens* is to be explained by a consideration of the arterial tension. Generally in these diseases little benefit is obtained from its administration, and yet in some cases its use has been crowned with marked success. It is said to be often curative in the *irritable heart of soldiers*.

Its use is contra-indicated in simple or compensatory hypertrophy and in fatty degeneration of the heart, apoplexy, aneurysm, and all diseases accompanied by high arterial tension, changes in the cardiac muscle, or atheroma of the blood-vessels, except for temporary use in an emergency.

In *pericarditis* it should not as a rule be employed, but it has been strongly recommended, particularly by Niemeyer, when there is a very rapid and feeble cardiac action together with cyanosis and dropsy.

In diphtheria and in all inflammations of the gastro-intestinal tract it is contra-indicated. It was highly recommended by Liebermeister in *typhoid fever*, but now it is considered at least useless in that disease, and it is apt to increase the diarrhœa and to cause vomiting. Nevertheless, in the *typhoid state* of exhausting fevers with *congestion of the lungs* it is useful to relieve the stasis.

In *pneumonia*, when the right side of the heart is embarrassed, it may prove of great service. When this happens it usually accompanies a sudden fall of temperature and is indicated by cyanosis. Particularly if the lips turn blue when the patient is turned from side to side, digitalis should be given together with oxygen and iron.

It has been recommended in *erysipelas*.

In *pyrexia* it may reduce the temperature, and formerly it was considerably used for this purpose, but it is unreliable, a high temperature seems to interfere with its action, it is slow, requiring from thirty-six to forty-eight hours to produce its effect, and it is apt to irritate the stomach, so its use as an antipyretic has been for the most part discontinued. In *rheumatic fever* it is alleged by some to reduce the temperature, to shorten the duration of the disease, and to be particularly indicated to meet any cardiac complications which may arise. Others deny that it has any influence on the course or duration of this disease, and certainly cardiac complications may occur which would of themselves contra-indicate its use.

In *spermatorrhœa* it is a serviceable antaphrodisiac. In persons of a plethoric habit it is best to combine it with bromide of potassium, and in all cases careful attention should be paid to cold bathing of the genitals and to hygienic treatment.

Some cases of *exophthalmic goître* seem to have been benefited by this drug after a long course of treatment, but as a rule little if any benefit is obtained.

As a diuretic digitalis is useful in *congestion of the kidneys* when the circulation is sluggish, particularly when this is dependent on venous engorgement due to mitral disease of the heart. It is not a suitable diuretic in Bright's disease; it is very uncertain, it raises still more the already high arterial tension, and it may arrest the renal circulation so as to stop the excretion of urine; yet it has rendered good service in *renal dropsy*. It is of great value in renal disease when cardiac hypertrophy induced by this disease has failed and dilatation with mitral regurgitation has resulted. When digitalis is used in cases of renal disease it should be combined with nitroglycerin, sodium nitrite, or some other agent to dilate the renal vessels. In the early stage of *scarlet fever* and when in that disease the kidneys fail to work, it has been used with benefit.

As a hæmostatic digitalis is mainly useful in *hæmorrhages* from large surfaces, in the *hæmorrhagic diathesis*, *post-partum hæmorrhage*, *metrorrhagia*, and *menorrhagia*, especially when dependent on mitral disease, and in *epistaxis*.

Combined with moisture and heat, digitalis seems to act as a sedative in *local inflammations*, such as those of the *joints* and of the *testicle*. It is readily absorbed by the skin and carried by the circulation to the kidneys, where it acts as a diuretic. Effective stimulation of the kidneys may often be obtained in cases of suppression of urine by the application of ½ a fl. oz. of the tincture sprinkled on spongiopiline or flannels wrung out of hot water, or of a poultice made of the leaves, to the loins or to the abdominal walls. A good plan is to apply dry cups to the loins previous to this application of a digitalis poultice or spongiopiline. *Bronchial congestions*, especially if due to heart disease, may often be relieved by such a local application to the chest wall.

Sometimes digitalis is administered to a patient for several days with no apparent effect, and then suddenly symptoms of poisoning appear. This is known as the cumulative action of the drug, and various hypotheses have been advanced as explanations. One hy-

pothesis is that it may stop its own excretion by its action on the blood-vessels, but we do not know how it is excreted, and think that it is probably oxidized in the tissues. Another hypothesis, based on the fact that it is apt to occur when ascites has been removed by tapping after the drug has been taken for some time, is that sudden withdrawal of pressure from the great vascular trunks in the cavities of the body induces the absorption into the circulation of the drug from the tissues in which it has been remaining in a state of inactivity. Another is that when doses are administered too close together, so as not to permit of the elimination of one before the ingestion of another, the heart becomes overstimulated and suddenly fails. Whatever may be the true explanation, this is an important and dangerous action which must be carefully watched for and avoided when a patient is under a prolonged course of treatment.

Digitalis is useful, as it is a physiological antagonist, in *aconite poisoning*, but it is slow in its action, so it should be preceded by ammonia and alcohol. In *muscarine poisoning* the digitalin is to some extent antidotal, but can not take the place of atropine.

The powdered leaves, infusion, extract, tincture, and fluid extract are official, but the infusion and the tincture are the preparations most commonly employed. The effects produced by these two differ a great deal. Digitalin and digitoxin, two of the three active cardiac-stimulant principles, are insoluble in water, but soluble in alcohol. Digitonin, which is supposed to be the diuretic principle, is insoluble in alcohol, but readily soluble in water. The infusion contains digitonin and digitalein; digitonin tends to depress the heart, digitalein to stimulate it. A predominance of either is not marked, but the diuretic action of the drug is strongly displayed. The tincture contains all three cardiac-stimulant principles, but no digitonin. If this is borne in mind it is not surprising that in practice it is found that the infusion is not a serviceable cardiac stimulant, or that the tincture does not act well as a diuretic.

When the tincture is used it is recommended that it should be given on sugar or bread, and no water should be allowed the patient for several minutes before and after swallowing it, as the digitoxin is precipitated by water. It is also not advisable to put up the tincture in water or a syrupy mixture, not only because the digitoxin is precipitated, but also because a decomposition is apt to occur which may destroy these active principles and create new ones with whose nature we are still less acquainted.

[The maximum single dose of powdered digitalis is 7 grains, and the maximum daily amount 15 grains. The ordinary dose of the tincture, *tinctura digitalis* (U. S. Ph., Br. Ph., Ger. Ph.), is from 10 to 20 minims. The dose of the infusion, *infusum digitalis* (U. S. Ph., Br. Ph.), is from 1 to 4 fl. drachms; that of the extract, *extractum digitalis* (U. S. Ph.), is ¼ of a grain; that of the fluid extract, *extractum digitalis fluidum* (U. S. Ph.), is from 5 to 10 minims.]

MATTHIAS LANCKTON FOSTER.

DIGITONIN, DIGITOXIN.—See under DIGITALIS.

DIIODOFORM, C_2I_4, carbon diiodide, represents 2 molecules of iodoform deprived of 2 molecules of hydriodic acid. It contains between 95 and 96 per cent. of iodine. It is insoluble in water, slightly soluble in alcohol and in ether, and freely soluble in chloroform and in benzene. The medicinal properties of diiodoform are precisely those of iodoform, and it has the advantage of being without any disagreeable odour; on the other hand, it is very expensive and decomposes if exposed to light, liberating iodine. In Squibbs's *Ephemeris* for January, 1895, M. Hallopeau's experience with it is cited. The matter having been brought up before a meeting of the Paris Therapeutical Society, M. Hallopeau stated that he was then engaged in a series of investigations on the therapeutical action of diiodoform in the dermatological wards of the Hôpital Saint-Louis. He had already found that as favourable results were obtained with it as with iodoform in the treatment of *soft chancres.* Both he and M. Brodier reported to the society their results in twelve cases of simple chancre, and they drew the following conclusions: It may be used exactly like iodoform; it usually cures in from eighteen to twenty days; neither pain nor irritation is experienced; it has no odour if kept away from light and air; it may act like iodoform in not curing cases of *phagedænic chancre;* applications should be made several times a day; it is best to keep the ulcer spread with absorbent cotton well saturated with it; in general it is used with good results in all suppurations where iodoform has been applied successfully.

M. Mayet (*Nouv. remèdes*, 1894, p. 324; Merck's *Report*, March, 1895) recommends the following formula for an antiseptic and anodyne ointment:

℞ Diiodoform.............	40 grains;
Cocaine hydrochloride...	8 "
Oleinic acid............	½ drachm;
Sterilized vaseline.......	13 drachms.

Mix.

This ointment is used in the treatment of *wounds, boils, carbuncles, burns,* etc., also, inserted into the vagina on cotton tampons, for the relief of *pelvic pain* of a neuralgic character, especially *neuropathic hysteralgia.*

DIIODOSALICYLIC ACID, $C_{14}H_8I_2O_2O_6$, is described by M. Bocquillon-Limousin as a crystalline powder soluble in alcohol and in ether, acting as an analgetic, antiseptic, and antipyretic. Its sodium salt, sodium diiodosalicylate, says the same writer, is used in *articular rheumatism* in doses of 7 grains from once to four times a day.

DIIODOTHIOPHENE, $C_4H_2I_2S$, has been recommended as a substitute for iodoform. It is said to contain 75·5 per cent. of iodine and 9·5 per cent. of sulphur. Its odour is aromatic, not disagreeable. It occurs in white crystals,

insoluble in water, but soluble in ether, in chloroform, and in hot alcohol.

DIISOBUTYLORTHOCRESOL IODIDE.—See EUROPHENE.

DILL, *anethi fructus* (Br. Ph.), the dried fruit of *Anethum* (*Peucedanum*) *graveolens*, is an agreeable aromatic employed in the *flatulent colic of infants*. From 1 to 4 minims of the volatile oil, *oleum anethi* (Br. Ph.), may be given on sugar. The dose of dill in powder is from 15 to 60 grains; that of dill water, *aqua anethi* (Br. Ph.), is from 2 fl. drachms to 1 fl. oz.

DILUENTS.—By a diluent we mean an agent which is absorbed into the tissues and dilutes the fluids therein contained. The excretory fluids are thus enabled to hold in suspension a larger amount of solid excrementitious material, though in a less concentrated condition, and so the elimination of the latter is facilitated while the excretions themselves are rendered more bland and less irritating. Water is the only agent included under this definition. Its action is to flush the overburdened excretory organs, to lighten their labour by furnishing a less concentrated fluid to pass through them, and to incite them at the same time to a greater activity. Thus it acts as an efficient adjuvant to the various drugs employed as diuretics, diaphoretics, antiblennorrhagics, etc., in addition to its primary action in diluting the tissue fluids.

The indications for its use are not only those which require these special stimulants of excretory organs, but also the condition of torpidity of the system, when the emunctories seem to be choked, the mind and body to be listless, and yet there is no special disease. Exercise and gentle laxatives are extremely beneficial in this trouble, and thorough, systematic washing, both inside and outside, has an excellent effect. The outside washing is a bath. The inside washing is an internal bath obtained by pouring into the system a sufficient quantity of water. It does not suffice to drink enough water simply to allay the thirst, but larger quantities, from two to four quarts or more, must be taken daily.

A very pleasant manner of taking water thus, as a medicine, is in the form of the various table mineral waters which at present abound in the market. The most important feature to be considered in regard to these waters, when employed for their diluent qualities, is the comparative absence of mineral constituents which make water "hard," and may excite gastric disturbance if taken in too great quantity.

Such a water as the Highland or Bethesda is often preferable to the highly advertised waters which are alleged to have wonderful solvent qualities on account of a small proportion of a certain mineral ingredient. The solvent property of these waters is largely, if not wholly, due to the action of water as a diluent. The principal merit of them all is this comparative absence of mineral constituents and of such impurities as are inevitably present in water drained from a populous district.

The best water to use as a diluent, unpalatable as it is, is distilled water. Enormous quantities of this may be drank daily, and the emunctories thus thoroughly flushed without interference with the healthy action of the digestive tract.

Certain mineral waters, such as those of Carlsbad, Saratoga, and Richfield Springs, merit the reputation they enjoy on account of the medicinal properties of the solids held in suspension; but probably the diluent action of the water itself plays an important part in the improvement of the health of those who flock to those resorts and partake of the waters.

MATTHIAS LANCKTON FOSTER.

DIMETHYLACETAL.—See under ACETAL.

DIMETHYLKETONE.—See ACETONE.

DIMETHYLOXYQUINICINE. — See ANTIPYRINE.

DIMETHYLPIPERAZINE TARTRATE.—See LYCETOL.

DIOSMA.—See BUCHU.

DIPHTHERIN.—See OXYQUINASEPTOL.

DISCUTIENTS.—See SORBEFACIENTS.

DISINFECTANTS.—See ANTISEPTICS.

DITA BARK.—See ALSTONIA.

DITHIOSALICYLIC ACID. A compound expressed by the formula

$$\begin{array}{l} S—C_6H_3 \begin{cases} OH \\ COOH \end{cases} \\ \;| \\ S—C_6H_3 \begin{cases} COOH \\ OH \end{cases} \end{array}$$

and its sodium salt, sodium dithiosalicylate, have been used like salicylic acid and the salicylates in *acute articular rheumatism*. Sodium dithiosalicylate is a very hygroscopic grayish-white powder, readily soluble in water. The dose is 3 grains.

DIURETICS are agents which increase the excretion of urine. The substances normally eliminated by the kidneys are water, nitrogenous crystalline bodies, such as urea, uric acid, hippuric acid, creatinin, xanthin, etc., inorganic salts, principally the chlorides, phosphates, and sulphates of sodium, potassium, calcium, and magnesium, pigments, and ferments. The quantity of non-nitrogenous bodies normally excreted is at most very small and uncertain. These are all carried in solution by the blood to the kidneys, which perform the work of excretion in a double manner. The water and some, if not all, of the inorganic salts are separated from the blood in the glomeruli, either by a process of simple filtration or by means of active secretion on the part of the glomerular epithelium, while the urea, uric acid, and other products of metabolism are separated from the blood by the action of the epithelium of the uriniferous tubules. Certain medicines and poisons are probably also excreted by the epithelium of the uriniferous tubules.

The kidneys are particularly well supplied with blood-vessels and vaso-motor nerves, and their work is to a great degree dependent on the flow of blood through them, so that a decrease in the arterial blood-pressure from any

cause is accompanied by a diminution of the renal secretion. When this is the case the quantity of urine may be increased by an augmentation of the general arterial blood-pressure due to an increase of the force and frequency of the heart's action, by contraction of the walls of the arteries throughout the body with the exception of the renal, and by a dilatation of the renal arteries and arterioles with no corresponding dilatation of the rest of the arterial system. To an extent the kidneys regulate their own blood-supply so that when the secretory epithelium is excited to activity by the presence of certain substances in the blood the renal arteries dilate and a more abundant local flow of blood results, irrespective, perhaps, of the condition of the general circulation. A corollary which might properly be deduced from this fact, and one found in practice to be true, is that a substance which excites the renal epithelium to increased activity will, when present in too great abundance, be likely to cause irritation or inflammation and produce a result exactly the opposite to that which is desired.

In a state of health the kidneys are competent to excrete the full amount of excrementitious substances formed in the tissues and intended for elimination through these organs, and the arterial blood-pressure is usually at its maximum height. Hence many diuretics do not materially affect the excretion of urine when the body is in a healthy condition, but in certain diseased conditions of the body the kidneys are unable to accomplish their work without aid.

Diuretics act in two general ways—by raising the arterial blood-pressure by means of their action on the heart and the arterial walls, and by increasing the activity of the renal circulation in particular. The former are ordinarily known as indirect, the latter as direct diuretics.

The indirect diuretics include the vascular and cardiac stimulants, such as digitalis, squill, scoparius, diuretin, and calomel. They are indicated when a low renal arterial pressure is due to disease accompanied by *venous engorgement* or *weak cardiac action*, and in these diseases they often display great power.

Greater in number are the diuretics which affect the renal circulation locally. These probably act for the most part by stimulating the excretory nerves and cells, by increasing the quantity of fluid to be excreted, and possibly in some cases by direct action on the renal arterioles. They may be divided into three classes—diluents, salines, and stimulants.

Water is a very important diuretic. When it is absorbed into the system in large quantities it does not increase the blood-pressure, but by its presence in the renal blood it excites the kidneys to greater activity and at the same time lightens their labour by rendering less concentrated the solution of materials which demand excretion. (See Diluents.)

Almost all the alkaline salts act as diuretics when given in small doses and sufficiently diluted, but usually the vegetable salts of potassium, sodium, lithium, calcium, and magnesium are meant by the term saline diuretics. The acetate, citrate, and bitartrate of potassium are the most powerful and the most commonly employed. Each of these is changed in the tissues to the carbonate, and as such is eliminated. The salines excite the renal epithelium, induce a hyperæmic condition of the kidneys, and increase the water in the urine. Some of them also increase the solid constituents, probably by uniting in the tissues with insoluble materials so as to form soluble compounds which may readily be eliminated. This is the probable action of the potassium and lithium salts in diseases characterized by excess of uric acid. Large doses, particularly of the potassium salts, render the urine alkaline. The saline diuretics are indicated in conditions of *renal inactivity*, due to either functional or organic causes, to promote the absorption of local *effusions* which are the results of inflammations of serous membranes, after the inflammatory symptoms have passed away, to promote absorption of *dropsical effusions*, and to neutralize *acidity of the urine*. In *dropsy of cardiac origin* they are sometimes very useful as adjuvants to the indirect diuretics, but can not take their place. In *renal dropsy* they are sometimes very beneficial, but when they do not readily produce diuresis their use should not be persisted in, because if the renal epithelium is so damaged that it can not remove the surplus water from the blood it is unable to eliminate these medicines, which will therefore accumulate in the system and may cause serious disturbance. It is better in such cases to discontinue the use of these salts for a while and from time to time to give them in a tentative manner to determine whether or not the renal epithelium has sufficiently regained its functions to allow of their use. When simple diuresis is desired from the salines a small dose, frequently repeated, in half a wineglassful of water, should be employed. When it is wished to neutralize the acidity of the urine larger doses at longer intervals are preferable.

Under stimulant diuretics are included those whose specific action is directly upon the renal tissue. In small and moderate doses they dilate the renal arterioles, increase the renal blood flow, and so induce diuresis, but in large doses they produce irritation of the excretory epithelium, induce contraction of the renal arterioles, cause a diminution of the renal blood-supply, provoke inflammation, render the urine albuminous and bloody, and may result even in suppression of the urine. The most important are cantharides, juniper, oil of turpentine, copaiba, and cubeb. Such a diuretic is contra-indicated in acute nephritis and should rarely be used in any form of nephritis, except in some cases where the kidneys are inactive on account of atony or prolonged chronic or subacute disease. In these cases benefit may be obtained from the use of such a renal stimulant, but it should be used with caution and its action closely observed. Juniper is often a valuable adjuvant to the indirect diuretics in *dropsy dependent on cardiac or pulmonary disease*. Cantharides, copaiba, cubeb, and turpentine are useful in *catarrhal inflammations of the genito-urinary tract*.

Diuretics are used to reduce and to neutralize the *acidity of the urine*, to increase its excretion when, owing to a general vascular disturbance, the daily quantity of urine falls below the normal standard, to hasten the elimination of certain products of metabolism from the body, to assist in the removal of both local and general serous effusions, and in certain forms of kidney disease.

In *urethritis* and *cystitis* it is usually advisable to render the urine blander by making it less concentrated and irritating to the inflamed surface over which it must pass. This result is attained by means of copious draughts of water together with saline and other diuretics. (See ANTIBLENNORRHAGICS.)

In cardiac and pulmonary disease attended by a decrease of the arterial blood-pressure the indirect diuretics are, as has already been said, of great value. It may here be remarked as true in regard to the administration of diuretics in the majority of cases in which they are indicated that, as there are many causes which produce a diminished excretion of urine, and as it is usually difficult to determine in any particular case what the exact cause of the diminution may be, it is ordinarily advisable to give various diuretics in combination. Thus, in *dropsy due to cardiac or pulmonary disease*, digitalis combined with squill and the salines is more likely to give satisfaction than digitalis alone.

To hasten the elimination of the products of metabolism the saline diuretics, particularly the salts of potassium and lithium, are very efficient. In diseases marked by *excess of uric acid* the potassium and lithium salts are beneficial not only on account of their diuretic action, but also because they unite in the tissues with the uric acid to form soluble salts.

In *localized serous effusions* the saline diuretics are to be preferred as a rule. Sometimes they cause the effusions to disappear almost as if by magic, but very frequently little or no benefit will be obtained. This is true also of the action of diuretics in *general dropsy*, and they are usually ineffectual when the fluid by its own pressure impedes the circulation. In dropsy the diuretics indicated are those which act most directly on the diseased organs; thus, when it is of cardiac origin, digitalis, diuretin, squill, and calomel; when it is due to hepatic trouble, copaiba; and when it is from renal disease, diuretin, scoparius, nitrous ether, and the salines are indicated.

How far it is desirable to stimulate the kidney in *nephritis* is sometimes a question difficult to answer, and therefore a rule for the use of diuretics in renal disease is not easy to formulate. Those which are gentle in their action, like water and the salines, are the only ones which should ever be employed. When the urine is of high specific gravity, but deficient in quantity, this deficiency not being the result of excessive perspiration, diuretics are indicated to increase the excretory fluid. When the urine is deficient in both quantity and solid constituents, as in *scarlatinal* and *acute nephritis*, diuretics are often of the greatest value in re-establishing the normal secretion, but the danger of irritating the congested and inflamed organs must be borne in mind, and the physician must rely upon his own judgment to guide him in any particular case in regard to the administration or continuance in the use of diuretics.—MATTHIAS LANCKTON FOSTER.

DIURETIN. — See SODIO - THEOBROMINE SALICYLATE.

DJAMBOE.—Under this name the leaves and root-bark of *Psidium pyriferum* (one of the trees that yield guavas) are used in Java as a domestic remedy for cholera. Dr. K. Hugel, of the Poliklinik of the Univerity of Würzburg (*Münch. med. Woch.*, July 17, 1894), gives his experience in the use of the leaves during a period of three years. In various forms of *infantile diarrhœa*, including several hundred cases of *acute gastro-enteritis*, he found it wonderfully efficient; generally the vomiting and purging abated after from three to four teaspoonful doses of a 5-to-80 infusion had been given. He also found the drug serviceable in the diarrhœal diseases of adults and in *dyspepsia*. The dose of the powdered leaves is from 7 to 15 grains, hourly or once in two hours.

DOLICHOS.—See MUCUNA.

DORSTENIA.—See CONTRAYERVA.

DOSES.—Considerable variation exists in the case of each drug as to the amount which it is proper to give as a single dose, and this amount is determined by circumstances which I shall present later. On account of this variation it is customary in naming the dose of a given drug to mention limits of smallness and greatness within which the dose shall lie, and we therefore refer to the smallest amount which will be productive of medicinal result as the minimum dose, while, on the other hand, the largest amount which it is safe to give at one time we term the maximum dose. The range of dose which lies between the maximum and minimum doses is called the therapeutic dose. Larger still than the therapeutic dose is the poisonous or toxic dose, the administration of which is followed by the development of the symptoms of poisoning peculiar to the drug. Fractional doses, which are smaller than the usual therapeutic doses, are administered for the purpose of gradually and at first almost imperceptibly producing physiological results. Divided doses are also fractional doses, but, though the terms may be used synonymously, are generally to be interpreted as larger than fractional doses. A full dose is a sufficient amount of a remedy to produce a pronounced effect, the condition for which the remedy is used being temporary and not requiring its continued employment. Full doses are, however, sometimes used repeatedly. The term interrupted doses refers to the frequency of administration, the intervals being sufficiently long for the disappearance of the symptoms due to the drug, or, in other words, to allow of an interruption of its physiological effects. Continuous or continued doses, on the contrary, denote such a frequency of administration that the effects of the drug are practically

uninterrupted. The same meaning is less forcibly expressed by the term repeated doses.

The size of doses, as has already been said, will vary with circumstances, and the conditions thus active are as follows: Age is the most important factor of all in determining the size of a dose, for though in adult life it is practically inoperative, and years in themselves have little or no modifying action, in infancy and childhood the dose variation is great and must be determined by the patient's age. The dose of a given remedy for an adult being known, and the doses given by medical works are invariably for adults unless the contrary is specified, it becomes necessary to have some method by which the doses for those of earlier years may be estimated. Of these methods there are several. Dr. Young's rule is to divide the age of the child by the age increased by twelve, and to take the result as the fraction of the adult dose which is proper for the child. Thus, at the third year the dose would be $\frac{3}{15}$ or $\frac{1}{5}$ of the adult dose. Dr. Cowling's rule states that "the proportionate dose for any age under adult life is represented by the number of the following birthday divided by twenty-four." According to this rule, the dose for a child three years old would be represented by $\frac{4}{24}$ or $\frac{1}{6}$ of the adult dose. In whatever way the child's dose is determined, it must not be forgotten that narcotic drugs are ill borne by children, and therefore the doses should be proportionately smaller than for adults, while of cathartics and belladonna the opposite is true, and of these children may take amounts relatively large. In old age, too, depressant remedies must be used in doses smaller than in adult life. These rules, indeed, are not mathematically reliable as adult years are approached, but no serious mistake is likely to occur from the fact that while at the twenty-first year a full adult dose is generally given, Young's rule would require at that age $\frac{21}{33}$ or $\frac{7}{11}$, and Cowling's $\frac{22}{24}$ or $\frac{11}{12}$ of the adult dose.

The size or weight of the individual is, in general, a more accurate guide to determining a dose than the age is, for the action of remedies, especially those whose effects follow absorption by the blood, is largely governed by the size of the dose in proportion to the person's weight. Though in most persons under twenty-one years old the age and weight have a pretty constant relation, yet variations are common, and therefore it is important to take them into account. Dr. Clarke devised the following method for determining doses according to the weight: Taking the average weight of adults as 150 pounds, he divided the weight of the patient by 150 and took the result as the fraction of the adult dose appropriate to the case. Thus, a child weighing 25 pounds would properly take $\frac{25}{150}$ or $\frac{1}{6}$ of the adult dose, while for a person weighing 200 pounds the dose would be $\frac{200}{150}$, or the usual adult dose plus $\frac{1}{3}$. It is not safe, however, to conform arbitrarily to this rule, for important circumstances may enter into the case and make some modification necessary; such conditions as obesity, pregnancy, and dropsical effusions, for example, much increase the weight, but do not demand a corresponding increase of dose. The method may be inconvenient, too, from the occasional necessity of weighing the patient. Practically, therefore, the modifying application of weight to dose is roughly estimated to the extent that to the small and poorly nourished we administer smaller doses than to the large and robust. Sex to some degree will modify doses, for females are less resistant to medicinal agents than males are, and therefore in general will require doses somewhat smaller. In pregnancy or lactation and during menstruation violent or energetic remedies must be withheld or used most cautiously.

Habit will greatly influence the dose, for to him whom use has accustomed to a drug much larger doses must be given to produce an effect. The large quantities of stimulants required by "alcoholics" in disease illustrates this, as does also the necessity for large doses of narcotics in those habituated to them. Even if the patient has not previously been accustomed to the remedy, the continuance of the disease may require a steady increase of the dose, for there are many drugs to which the system soon accustoms itself and the doses of which must necessarily be increased in order that their therapeutic effects may be kept up.

Idiosyncrasy is that peculiarity of individuals which makes them respond to a remedy in a manner unusual. Susceptibility is that characteristic evinced by a response relatively exaggerated as compared with its cause. Resistance, as therapeutically understood, means the capability of withstanding the action produced ordinarily by remedies. These characteristics are peculiar to individuals and must be determined by experiment, though, as a rule, resistance may be expected in the phlegmatic and susceptibility in the nervous. The peculiarity of the individual having been found out, it becomes necessary to so increase or diminish the dose of the remedy to which reaction is peculiar that proper response shall follow its exhibition and untoward occurrences shall be avoided, or else withhold it altogether.

The nature of the disease will much affect the dose, not only, as has already been said, because the long continuance of the ailment will often require a constant increase to overcome the acquired resistance, but because many diseases in themselves make large doses tolerable—doses which given in health or in other conditions might even be poisonous. An example of this tolerance afforded by disease is seen in the enormous doses of opium borne by the patient with peritonitis. Some other diseases require doses unusually small, and they are generally those in which the organs of elimination are affected, especially the kidneys, for if elimination is obstructed there may remain in the body such amounts of the drug as to produce a toxic effect, and this, too, after doses which, under other circumstances, might be eminently proper. An example of this necessity for a decrease of dose is seen in the over-effect often produced by opium in persons suffering from kidney diseases. Severity of disease, too, will demand larger doses as

a rule; an illustration is furnished by intermittent fever, for in pernicious cases doses of quinine are required that are far in excess of those that are effective against the ordinary mild cases.

The end or action sought will, of course, modify the dose, for quinine may be given as a simple bitter in doses of 1 or 2 grains, while as an antiperiodic doses much larger will be required. So, also, ipecac in small doses is expectorant, but in large doses is emetic, and what is exemplified by quinine and ipecac is true of a large number of drugs.

The time of administration will also to some degree affect the dose, for gastric absorption is not only more rapid when the stomach is empty, but probably more complete, and therefore a lesser amount may suffice when the remedy is given before meals than when it is given after eating. Of course there are some remedies suited only to administration at certain times, and my remarks therefore apply only to the relative amounts required when the time for giving them is not arbitrary. The form in which the remedy is administered will also affect the size of the dose, for a remedy in solution undergoes not only a more rapid absorption, but one which is more complete.

The method of administration will greatly modify the dose. The dose of a remedy given in medical literature is invariably the dose to be given by the mouth unless otherwise specified, but this will certainly not be suitable for administration by other channels, and a modification of the amount is therefore necessary for giving the drug by the rectum or by hypodermic injection. For rectal administration the dose of a remedy is usually twice its dose by the mouth, unless the remedy is one that is absorbed with unusual rapidity or is unusually potent. For hypodermic injection the dose is generally from half to a quarter of the dose by mouth, but in the case of all drugs of great potency, especially if there is a doubt as to their strength, the beginning dose should be even smaller, and only with the knowledge acquired by experience should an increase be made.

Imagination certainly has a modifying effect upon the action of remedies, and the expectation on the part of a patient that a certain dose will produce a certain effect doubtless contributes much to the production of that effect, as will prejudice on his part against the remedy perhaps tend to retard or diminish its action. Doses may therefore be subjected to some modification in such cases, but an increase of dose should be made only after careful determination that the resistance of the patient is real. Of diminishing the dose or entirely withholding the remedy in imaginative cases, and still accomplishing the same and even greater effects, provided the faith of the patient is maintained, we all have ample experience.

Climate, race, and occupation are factors which may exert a modifying influence upon doses, but rather, probably, because they are associated with some of the undoubtedly active factors I have detailed than because they are individually and of themselves operative.

In determining the dose proper under certain circumstances caution must always be observed in using a new drug or a new preparation, and in treating a patient whose peculiarities, whether of personality or of disease, are unknown. With a first dose judiciously small the subsequent doses may be so regulated that the effect sought for shall be produced and maintained, bearing in mind that doses are not arbitrary, but are to be regulated solely by the effect produced. Thus cautiously and wisely regulated, doses become, so far as the case under treatment is concerned, however they may differ from the text-book doses, neither large nor small, but sufficient.

Henry A. Griffin.

DOUCHES are continuous columns, jets, or streams of liquid or gas directed upon the surface of the body or into one of its cavities. A liquid douche may be either cold, tepid, or hot, and the fluid may have either a descending, ascending, horizontal, oblique, or vertical direction. The effect of a douche varies with the size of the jet, its force, and the temperature of the fluid.

While different portions of the body have different degrees of tolerance of the douche, there is less reaction to a douche applied to the head or extremities than to one applied to the chest or abdomen, and the back and spinal region react less quickly than the chest and face.

The immediate effect of a cold douche is, in general, a feeling of shock, associated with spasmodic respirations and sometimes with palpitation of the heart and a feeling of fulness in the head; there are transitory local anæsthesia, alternating contraction and expansion of the cutaneous capillaries, and a reduction of the local temperature. The respirations become deeper and sometimes slower, and sometimes they remain spasmodic during the entire time the douche is administered; there is diminished frequency of the pulse, and in proportion to the force of the jet and the reaction there is increased tissue metabolism. The skin is blanched, and this may be followed by reddening, but occasionally an individual does not react well, and it is some time before the capillary vessels regain their normal tone.

While cold douches are usually easily tolerated after a few applications, warm douches cause less shock and are much more easily borne. An alternation of hot and cold douches is known as the Scotch douche, and in it the hot water rapidly restores the irritability of the region benumbed by the cold water.

A douche may be universal or general, applied to the entire body, or local, applied to some region or part; it may be stationary, or it may be mobile and applied in succession to the various parts of the body.

The descending douche may be administered either as a shower bath, in which a number of fine jets are projected from a height varying from six to eight feet, or it may be a

column of water not more than four inches in diameter and falling from a height not greater than ten feet. This latter is called a column or columnar douche. The water, falling under different pressures, produces different effects. In general it is in the nature of a continuous massage. It may be applied to the head as a cephalic douche in *neurasthenia;* to the dorsal region for *rheumatism* and to stimulate the functions of the kidneys, and is known as a dorsal douche. This may be administered as a transition or alternating douche, hot succeeding cold water. If the descending douche is arranged like a shower-bath it is called a rain douche and is useful when applied to the head in *maniacal excitement, infantile convulsions,* and *neurasthenic conditions.*

The ascending douche is a stream of water directed upward, and it is usually employed in *hæmorrhoids, ulcers,* and *catarrhal inflammation of the rectum;* as a rectal douche in constipation; in the various forms of *elytritis* as a vaginal douche; in *perimetric inflammation;* and in certain forms of *chronic metritis* as a uterine douche. It is also used as an anal douche in *pruritus ani.* A continuous rectal or a perineal douche has been successfully employed in *prostatic congestion* and *seminal weakness;* the ascending cold douche in the rectum is particularly useful in *atonic conditions of the seminal vesicles.*

The horizontal douche is a fine or large stream of water so directed that its impact against the body is horizontal. A large stream is employed for the hepatic douche, the column of water being directed against the various parts of the hepatic region. This douche is useful in *hepatic congestion* and other *functional disorders of the liver.* A horizontal douche applied over the region of the spleen is called the splenic douche and is used in *anæmias,* as well as in *splenic hypertrophy* due to *paludal poisoning.* A horizontal douche directed against the epigastric region is used to stimulate the stomach in *atonic dyspepsia.* The lumbar douche is a horizontal douche directed upon the lumbar region for *lumbago.* Where it is desired to have the horizontal douche cover a large area a fan douche is used; this is produced by a metal tip that spreads like a fan, having a slit or perforations at the circumference.

The circular or ring douche is a general horizontal douche administered by a series of parallel ring-shaped pipes, separated for from eight to fourteen inches. If these pipes are arranged so as to make a bell-shaped figure, they make a bell douche; and if the pipes have concentric slits, so as to send forth concentric circular sheets of liquid, the result is a concentric douche. These varieties of the horizontal douche are useful in the treatment of *anæmia, incipient tuberculosis, chorea, neurasthenia,* and conditions in which there are aberrations of normal metabolism of the body.

A sheet douche is a general douche in which the water is delivered in a sheet through a slit. This, like the ring douche, is useful in *hysterical* and *chlorotic conditions,* and *melancholia, cerebral anæmia,* and *general debility.*

A steam douche, consisting of a jet of steam, may be employed with great caution where a decided revulsive action is desired. A vapour douche may be obtained by attaching a pipe to a vessel of boiling water, and is used in *nasal, laryngeal,* and *pharyngeal* inflammations, and to stimulate and relax the gravid uterus when a hot bath can not be administered.

By means of the compressed-air douche water is forced at such pressure that, in the capillary douche, in which the jet emerges through a very fine aperture, the steam will, it is said, perforate the tissues. Under moderate pressure it produces a wheal-like elevation of the skin. It is used in the treatment of local *neuralgia* and *rheumatism.*

The *aural, nasal,* and *ocular douches* are streams of water used in those regions. The air douche is an auricular douche in which a current of air is forced through the Eustachian tube into the tympanic cavity.

A gas douche of carbonic acid has sometimes been employed as a local application and anodyne in *uterine cancer.*

The temperature of the water in the douche should be regulated as was directed in the article on BATHS.—SAMUEL T. ARMSTRONG.

DRASTICS are vegetable purgative medicines "which cause great irritation of the alimentary mucous membrane, and in overdoses are violent poisons" (H. C. Wood). The cathartics generally classed as drastics are colocynth, scammony, elaterium, elaterin, jalap, podophyllum, croton oil, gamboge, bryony, iris, chelidonium, and euonymus.

The clinical application of the drastic cathartics is in cases where it is desired to make a profound impression upon the system, and especially for the production of revulsion in various cerebral affections. They are contraindicated in irritation and inflammation of the gastro-intestinal canal as well as in organic intestinal obstruction and general adynamic conditions. The distinction between the more active purges and drastics is one of degree rather than of kind, and is largely determined by the dose, for, in amounts sufficiently small, the drastics may even be not more active than laxatives. The association between drastics and hydragogues is especially close, and several of the remedies I have named might with equal propriety be classed with the hydragogues. Combinations of drastics with other drugs used as adjuvants and corrigents are common, an example being had in the much-used compound cathartic pill. Their use uncombined is infrequent unless revulsion or hydragogue purgation is sought. (See CATHARTICS.)

HENRY A. GRIFFIN.

DRAUGHTS.—Epispastics are sometimes familiarly termed draughts, but generally the term is applied to the *haustus* of the old pharmacopœias, namely, liquid medicinal preparations intended to be swallowed undiluted, and especially those dispensed in an amount to be taken at a single dose. Black draught is the *infusum sennæ compositum* of the U. S. Ph., the *mistura sennæ composita* of the Br. Ph. Cf. EFFERVESCING PREPARATIONS.

DRINKS.—Under this head will be considered the various preparations which consist of remedial, nutritive, and what may be termed refreshing substances, combined usually with large amounts of water and used both in disease and in health to assuage thirst and promote diaphoresis and diuresis, etc.

The physiological and therapeutical effect of all fluids, in any considerable amounts, depends not only on the substances forming their bases, but also upon their temperature and upon the time and manner of their administration. All watery preparations, when taken as hot as they can be comfortably borne, are mildly stimulant to the circulation and respiration, and under ordinary circumstances promote diaphoresis. Their local action upon the mucous membrane of the stomach is stimulant and they increase to a certain extent the secretion of the gastric juice. These properties are well shown by the increased resistance to cold and fatigue following upon the use of hot tea or meat extract dissolved in hot water; without doubt the tea or meat extract plays some part in producing the result, but only a fractional one, as the same articles taken cold are comparatively almost inert. As appetizers, small amounts of clear soups act efficiently, and the practice of beginning a meal with them has a rational foundation. Also all hot drinks have a carminative effect. Lukewarm beverages are extremely unpalatable to most persons, and in sufficient quantities nauseate. This property depends in a measure upon the overfilling of the stomach, but in addition there is a genuine emetic action, as in the majority of instances an equal bulk of either hot or cold water is entirely without such effect.

Extremely cold or iced drinks, unless taken in small quantities and slowly, may act as depressants and in those unaccustomed to their use give rise to a condition approaching collapse, especially during hot weather. Often large amounts of cold fluids act unfavourably upon the stomach, and if taken at the time of eating may give rise to what is termed "ice-water dyspepsia"; and even if this condition is not set up, it is very certain that the gastric juice is too highly diluted to act properly upon the food, considerable quantities of which will pass out into the intestines in an undigested condition and become the cause of intestinal indigestion and often of diarrhœa. However, when sufficient time has elapsed after eating to allow of the action of the gastric juice upon the food, moderate amounts of fluid are advantageous, as they hasten and facilitate the passage of the contents of the stomach into the intestines. As a rule, it is well to avoid the drinking of much fluid for about two hours before eating. At other times, in the healthy, the personal inclination of each individual will dictate the amount of fluids that can be taken without inconvenience. In the *gouty* and *rheumatic diatheses* forced drinking of water, especially when distilled or from springs containing small amounts of mineral matters, or of fluids consisting largely of it, is an advantage, as it increases the excretion of the nitrogenous waste products of the system. On the other hand, large amounts of fluids are a disadvantage in the weakly and very young, as the increased destructive metamorphosis may lead to marked impairment of the strength. An insufficient amount of fluids may retard digestion, give rise to constipation, and render the urine of such high specific gravity that it will irritate the kidneys and bladder.

Among diseases there is no class in which the thirst is as tormenting or in which undue amounts of drink will do so much harm as in *fevers*. If left to themselves, patients will drink almost continuously, with the result of deranging the digestion and giving rise to colic and flatulence and even diarrhœa. To them only small amounts, from 1 to 2 oz., should be given, and if possible at intervals of not less than an hour. Plain water is not so satisfactory as that to which a slight bitter taste has been given by cascarilla, hops, or any simple bitter. Sweetened drinks as a rule increase the thirst. The aromatic sulphuric acid and hydrochloric acid form desirable additions to water in these cases, and in a measure assist somewhat in digestion, especially the latter. In the severer fevers lemonade and limeade are not desirable, but in the milder ones, such as scarlet fever, measles, and the ephemeral fevers of children, they may be given, provided they are weak and contain but little sugar, almost *ad libitum* without any ill effects, and in the convalescence from scarlet fever they are of benefit on account of their diuretic effect. In both forms of *diabetes* abstinence from fluids has no appreciable effect upon the progress of the disease and adds very materially to the discomfort of the patients.

It is often difficult to determine just how much fluid is admissible in cases of *diarrhœa*, especially in infants, but as little as possible is to be given; not on account of any fear that it adds "fuel to the flame," but lest it may impair the digestion and thus aggravate the trouble. In all cases of illness it is not advisable to reduce the temperature of the drink too low by the use of ice. It should simply be not warm enough to be unpalatable, say of a temperature of from 50° to 55° F. All drinks having a mineral acid as a base must be given through a glass tube, and in conditions of extreme weakness a "duck" must be used. It is much more agreeable to a patient to have the glass or cup in which fluids are given of a size to contain only the amount to be taken at one time, and thirst is more readily satisfied than when only a portion of the contents of a vessel is allowed.

As a rule, carbonated water is more grateful than plain water, and, unless contra-indicated or when the preparation is to be heated, should be used. When it is not convenient or practicable to keep ice in a refrigerator or some specially prepared receptacle, such as a double tin box insulated with felt, etc., a moderate-sized piece may be kept in a flannel bag hung in a water-jar in such a manner that it does not touch the bottom, the whole being covered with a blanket, for a number of hours. If possible, when ice is used it should be kept in a

refrigerator in which nothing else than the food and drink for the patient is kept. When the temperature of any substance is to be reduced rapidly or to a low point the vessel containing it should be placed in a pail or some similar receptacle and surrounded with cracked ice and coarse salt. Table salt will do in any emergency, but is not so satisfactory.

Alcoholic drinks, unless a very rapid stimulant effect is desired, should have ice added to them, or they may be "frappéd" with the exception of the red and white still wines. Malt liquors are more agreeable when chilled in a refrigerator or a cool cellar.

An agreeable drink with slight laxative and diuretic properties may be prepared by putting from 2 to 3 oz. of tamarinds into a pint of water and, after thorough mixing, straining off the seeds, etc. It may be given in almost any quantities and is usually relished by children, especially when affected with the *ephemeral fevers of childhood.* A somewhat similar preparation is made by dissolving a tablespoonful of currant jelly in a tumbler of water. Some slight nutritive effect may be given this by boiling arrowroot in it, in the proportion of about a teaspoonful to the quart, and straining after it has become cold.

By soaking three slices of stale bread, toasted brown, in a quart of hot water, we make toast water. This, when iced, is sometimes useful in allaying nausea. It also forms an agreeable vehicle for the administration of stimulants, and is largely used in domestic practice in the *diarrhœa of infants*, being substituted for plain water, and in many cases appears to relieve thirst very satisfactorily. Moreover, it is slightly nutritious.

For persons in health, exposed to the rays of the sun or in rolling-mills, gas-works, etc., where the heat is intense and large amounts of fluid are necessary to supply that carried off in the perspiration, a mixture of a pound of oatmeal in a gallon of water is extensively used, and with extremely good results. Fewer cases of sunstroke, cramps, etc., occur than when plain water is used, and it should be, and is in many instances, supplied free to the men working under the conditions mentioned. Much of its good effect is due to the fact that it supplies a small amount of nutriment in a shape readily absorbed. Better than oatmeal water is a very thin watery gruel of oatmeal slightly sweetened. When this has been substituted for oatmeal water it has been found that the increased amount of work performed by those engaged in pushing a job more than compensates for the trifling cost of the oatmeal and sugar.

After rations of spirits ceased to be given to the haymakers in New England a mixture popularly known as "swizzle" was introduced. This is a mixture of molasses and water and a little ground ginger; it allays thirst satisfactorily, and may be taken *ad libitum* without any ill effects.

Barley water is extensively used in *febrile conditions.* It is made by boiling an ounce of decorticated or pearl barley in a quart of water until the bulk is reduced to one half, and straining off the barley. It is used cold, and is slightly nutritive, although a preparation in which malt is substituted for the barley is more so. To either, the addition of a small amount of hops gives a slight tonic and appetizing effect.

Parched and powdered sweet corn, infused for an hour in double its bulk of boiling water, is sometimes given to children, but, though somewhat nutritious, it contains rather too much sugar for very extended use.

An infusion of a pint of bran in a quart of boiling water is sometimes used in place of barley water, but it is not very palatable.

Flaxseed tea is made by infusing half an ounce of unground flaxseed in a pint of boiling water. It is a very desirable preparation for use in *dysentery*, *diarrhœa*, and all *irritable conditions of the genito-urinary tract*, for which latter conditions the addition of lemon-juice renders it more appropriate. When it is used as a demulcent drink in affections of the air-passages a piece of extract of licorice of the size of a hickory nut may be added with advantage.

Gum-arabic water, containing an ounce of the gum to the pint, was formerly used more extensively than at the present time in the *diarrhœa of infants.* It seems to have a soothing influence upon the mucous membrane of the alimentary canal. A more complex drink, suitable for adults, when it is desired to administer a diluted stimulant, is made by adding to it sherry and sugar.

One of the most agreeable drinks which can be used to allay the *irritation of the pharynx* and *larynx* in *acute colds* is made by steeping a handful of carrageen in two cups of boiling water for two or three hours and, after straining, adding lemon-juice and sugar according to the taste of the individual. If properly made, it should be of the consistence of a semi-fluid jelly, and may be used as freely as desired, a tablespoonful being allowed to trickle slowly down the throat. Sometimes the addition of a little glycerin heightens its efficiency. Ground slippery-elm bark, in the proportion of a teaspoonful to the cup of water, is sometimes used instead of the moss, but is much less palatable.

A slightly laxative drink which children take readily is prepared by soaking five or six apples, sliced thin, in a quart of hot water and straining after cooling. Sugar is usually added to this, especially when the apples are sour. It should be used soon after being made, as it is liable to undergo fermentation.

Raspberry vinegar used to be a standard preparation in most households, but is rarely seen now, although it affords a base for a very agreeable drink in warm weather and for invalids. It is made by pouring a quart of cider vinegar upon 3 quarts of ripe red raspberries. After standing for twenty-four hours the liquor is strained off and poured over an equal amount of the fruit. This at the end of a second twenty-four hours is strained and cleared by boiling, and to each pint a pound of white sugar is added. If bottled and corked while hot, this will keep indefinitely. When

used, it is mixed with four or more parts of cold water. A less agreeable substitute may be made by adding at the time of using a small amount of vinegar to the *syrupus rubi idæi* of the U. S. Ph. Almost any number of drinks may be prepared from the syrups of whatever fruit may be attainable, by the addition of carbonic-acid water prepared in one or another of the portable generators in the market or that drawn from siphons, but unless a small amount of gelatin is added they are apt to be flat and insipid. The gelatin should be previously dissolved and combined with the syrup. With the exception of those of sarsaparilla and vanilla, for which the extracts may be used, all syrups employed for this purpose should be made from the ripe, fresh fruits. To make "cream soda," fresh cream, in amounts not over half the bulk of the quantity drank at one time and sweetened to the taste, may be used, but ordinarily condensed milk is substituted. This latter form, provided too much sugar is not used, affords an agreeable nutrient drink for hot weather.

Currant shrub, or a mixture of the juice of red or white currants, sugar, and water, is palatable to most persons, allays thirst unless it is too sweet, and is slightly diuretic and, in sufficiently large quantities, laxative.

A very nutritive drink is prepared by stirring, not beating, the white of an egg in a tumblerful of iced water and adding a pinch of salt. It is readily absorbed, and, as it is digested almost exclusively by the stomach, is entirely suitable for use in *diarrhœa.* To a whole egg beaten until light a pint of hot water may be slowly added, the two being thoroughly mixed, with the result of forming a homogeneous mixture. A pinch of salt and a little sugar, if desired, may be added. This forms a very nutritious mixture. It is best served hot, and in cases of *exhaustion* or *collapse* it is highly efficient.

Whenever milk is the basis of a drink it may be made more agreeable to the eye and more palatable by the addition of a little gelatin dissolved in water. This gives more body, and if the mixture is whipped or beaten the foam is more persistent.—Russell H. Nevins.

DROPS, *guttæ*, are those small globular masses of liquid which detach themselves from a body of liquid contained within a receptacle and fall, when the arrangement of the vessel is such that a flow takes place from it which is insufficient to constitute a stream.

Measurement by drops is unscientific and inaccurate, for drops vary much in size, not only in liquids of different densities, but also in the same liquids when submitted to varying conditions of dropping. Fluids of much viscosity will naturally fall in drops of size larger than those of fluids less dense, while of conditions which will cause larger drops in the same fluid are a dropper of broad point or surface and the extremity of which is concave rather than convex; while smaller drops will fall from a smaller point or surface, especially if it is convex. For these reasons drops which fall from a full bottle are larger than those which fall from one only partly full. The expression of doses by drops is, however, so convenient a method of ordering that, in spite of its inaccuracy, the custom still prevails and is admissible when the latitude of the dose in the case of the remedy prescribed is such that a slight variation over or under the dose more accurately measured is not objectionable. It would conduce to scientific accuracy, however, if small doses of liquid remedies were ordered given in minims and the use of the minim graduate or pipette insisted upon. Minim does not mean drop, though the terms are often carelessly used interchangeably, and therefore if the dose of a given drug is stated in minims it is highly unscientific to interpret it as being of an equal number of drops, for sometimes the minim and sometimes the drop is the larger, according to the liquid dropped and the circumstances of the dropping. This error is committed every day. Though unscientific, it is not productive of harm in most cases, because the remedies prescribed are usually those of which the range of doses is considerable. Some writers prefer to state doses in drops, and, though the practice does not conduce to the harmony of medical literature, it is allowable so long as it is drops they mean and not minims. The term "drops" is sometimes used popularly to signify a medicine whose dose is usually measured by these quantities.—Henry A. Griffin.

DUBOISINE is an alkaloid obtained principally from the leaves of *Duboisia myoporoides*, a small tree or large shrub of the family of *Solanaceæ* found in Australia. It so closely resembles atropine, daturine, and hyoscyamine that it is frequently spoken of as identical with them. In its physiological action duboisine closely resembles atropine, but its effects are produced more quickly and strongly, and also pass off more rapidly. A marked difference is that duboisine is not a cerebral excitant, but is, on the contrary, calmative. It produces muscular relaxation and so predisposes to sleep, but observers disagree in regard to its possession of hypnotic properties. It augments the activity of the respiratory centre and depresses or paralyzes the inhibitory ganglia. Among the neurotic symptoms which sometimes are caused by its use are faintness, giddiness, loss of appetite, vomiting, a feeling of impending death, pain over the heart, hallucinations, and partial aphasia. As compared with atropine, duboisine is less irritating to the conjunctiva and to the mucous membranes generally. Physiological effects are sometimes produced by $\frac{1}{300}$ of a grain.

The sulphate is the salt most commonly employed. It occurs in a yellowish, soft, viscous mass, very soluble in water, reddened by sulphuric acid, and when warmed giving off an unpleasant odour like that of butyric acid. The dose ranges from $\frac{1}{300}$ to $\frac{1}{60}$ of a grain. The hydrobromide and salicylate are occasionally used for the same purposes and in the same doses as the sulphate.

The purpose for which duboisine is most commonly used is, in ophthalmic practice, to

dilate the pupil and paralyze the accommodation of the eye in order to determine the refraction. For this purpose a drop of a solution, 2 grains to the ounce, should be instilled into the eye three times the day before the examination and once on that day. The paralysis of the accommodation is as complete as that produced by atropine, and lasts only half as long. Recovery is perfect in from five to seven days. No stronger solution than that of 2 grains to the ounce should be used, for, though alarming symptoms rarely follow the use of a solution of this strength as a collyrium, they are frequently noticed after the use of a 4-grains-to-the-ounce solution.

As a therapeutic agent in diseases of the eye duboisine is not so good as atropine, on account of the greater danger of constitutional poisoning and of the shorter duration of the effect, but it is occasionally useful when a sharp effect is wanted or where atropine is not well borne.

Its use has been recommended in cases of *insanity* exhibiting great motor agitation not the consequence of hallucinations and delusions, to produce muscular relaxation. In the same manner temporary relief may also be obtained in *paralysis agitans*, giving the patient some hours of comfort. In advanced stages of this disease the effect of the drug on the speech is sometimes prejudicial, sometimes not. Aside from this, from $\frac{1}{300}$ to $\frac{1}{200}$ of a grain may be given two or three times a day without harm.

According to Belmondo, duboisine resembles hyoscine as a sedative in psychical or motor disturbances. In *acute mania* it acts as a psychical co-ordinator and seems to influence the course of the disease.

It has also been used in *puerperal mania* with good effect. In the *night sweats of phthisis*, in *respiratory neuroses*, and in *cardiac failure* it has been used to some extent, but it has not succeeded in supplanting atropine. In *morphine poisoning* it is quite as efficient as atropine.

Matthias Lanckton Foster.

DULCAMARA (U. S. Ph.), *douce-amère* (Fr. Cod.), *bittersweet*, is the young branches of *Solanum Dulcamara*, woody nightshade, a climbing plant of Europe and North America. Though the branches only are official, the root also is active, and the berries even have caused death in a child. The activity of dulcamara is mainly due to the presence of a poisonous alkaloid, *solanine* (this has also been found in *Solanum tuberosum*, or the common potato, when unripe and when germinating), though other principles have been found in the drug, and these have been thought to contribute to its physiological activity. Of these the most important is *dulcamarin*, a glucoside. Solanine appears as a white powder or as delicate crystals. It is without odour but has a very bitter taste. It is very little soluble in water, but is soluble in alcohol. It has been tried by various therapeutists, and, though some have thought it valuable as an analgetic and antispasmodic, it is at present little if at all employed.

Dulcamara is possessed of slight narcotic powers, but its main action is to stimulate secretions, and particularly those of the kidneys and of the skin. In large doses it may cause nausea and vomiting, while overdoses have caused prostration, vertigo, depression of the circulation, numbness in the limbs, coldness and pallor of the skin, and convulsive movements. The drug, however, has seldom caused death, the ingestion of amounts which were very large having been recovered from. In poisoning by dulcamara the proper treatment is to thoroughly empty the stomach and to administer such amounts of stimulants as may be necessary.

The remedy is one which is little used at the present time, but formerly was considerably employed in cases where its action to stimulate secretion made it valuable. Among the diseases it has been supposed to benefit are *bronchitis*, *rheumatism*, *gout*, *dropsy*, *jaundice*, and *chronic catarrhs* in general. Its benefits are more pronounced, however, in chronic skin diseases of a scaly character, such as *psoriasis* and *lepra*. In such cases it may with advantage be combined with an antimonial, and the internal employment may be supplemented by the external application of a strong decoction. The remedy has also been used as an antaphrodisiac.

The fluid extract of dulcamara, *extractum dulcamaræ fluidum* (U. S. Ph.), is given in doses of from ½ to 1 fl. drachm. An extract has also been prepared of which the dose is from 5 to 10 grains. A decoction (1 to 16) is the form in which dulcamara is generally employed; it may be given in doses of from 1 to 2 fl. oz. This amount indeed may gradually be increased until cerebral disturbances show the full physiological effect.

Henry A. Griffin.

DULCIN, or sucrol, a sweetening agent produced by heating phenetidine with urea, has lately been brought forward anew as a substitute for sugar in the diet of patients with *diabetes*. It is said to have two hundred times the sweetening power of cane sugar, and not to give rise, on prolonged use, to the dislike engendered by saccharin, etc. Its great insolubility is mentioned by Dr. Squibb as its chief disadvantage, but he adds that "hopes are entertained of overcoming this defect."

EARTHS are native powdery mineral substances. Finely powdered magnesia is known as *absorbent earth*; finely powdered baryta, lime, magnesia, and strontia are called *alkaline earths*; finely powdered aluminous schist is called *alum earth*; and calcium phosphate of animal origin is known as *animal* or *bone earth*.

Fuller's earth is a brown, yellow, or greenish-white amorphous earth which is only partly miscible with water, and easily absorbs

fatty substances; it has been applied as an absorbent to *irritated surfaces.*

[*Clinical Sketches* for August, 1895, says editorially: "We doubt if the application of this material for the purpose of absorbing unhealthy excretions is sufficiently recognised as a therapeutical agent. Prepared fuller's earth is freely used in the nursery in place of violet powder, and may be employed with benefit in many cases of *undue secretion of the skin* from various causes. It has the merit of not clogging the pores, as is apt to happen with the finer preparations of dusting powders. It seems to combine with all oleaginous matters, and is thrown off from the skin instead of remaining to clog the surface."]

Samuel T. Armstrong.

ECBALLIUM, *ecballii fructus* (Br. Ph.). See Elaterium.

ECBOLICS. — See Abortifacients and Oxytocics.

ECBOLINE.—See under Ergot.

ECCOPROTICS are remedies which are mildly purgative or laxative. The name is seldom employed at the present time, and the meaning it conveys—of mildness of action and of simple evacuation of the intestinal canal—is more commonly expressed by the use of the word laxatives. Besides the drugs that are eccoprotic there are many foods which possess this power, and in fact which are more generally useful and appropriate for the production of eccoprotic effects than drugs are. Among the foods thus useful are fruits, especially the fig and prune; coarse cereals, such as bran, cracked wheat, oatmeal, unbolted flour, and Indian meal; and molasses, honey, and sugars, but the use of sugars should be cautious and limited. Certain of the green vegetables, too, are valuable, also soups, eggs, bland oils, and cream. If laxative foods and similar mild measures are insufficient to produce the desired intestinal activity, eccoprotic drugs may be required, such as manna, tamarind, viola tricolor, frangula, cassia fistula, sulphur, and magnesia. The clinical application of eccoprotics is for the relief of *habitual constipation.* (See Cathartics.)—Henry A. Griffin.

EDULCORANTS.—See Corrigents.

EFFERVESCING PREPARATIONS are those which contain sufficient quantities of an alkaline carbonate and of a vegetable acid, usually citric or tartaric, to evolve, when combined with suitable amounts of water, considerable volumes of carbonic-acid gas, which gives rise to a brisk effervescence. In some instances the acid and the carbonate are mixed separately and afterward combined; in others the acid is added to the dissolved carbonate, or in some rare cases it may be desirable to administer each separately, so as to allow of the generation of the gas in the stomach. The latter method is sometimes adopted in some forms of dyspepsia, and to distend the stomach when it is desired to map out its outline. It should be hardly necessary to observe that when there is a suspicion of ulceration or other destructive lesion of the stomach the procedure is entirely inadmissible. Intestinal obstruction has sometimes been relieved by injecting a solution of an alkaline carbonate into the rectum and following it by one weakly acid, the gas working its way up beyond the ileo-cæcal valve.

At the present time very elegant preparations are obtainable, in which the acid and carbonate are thoroughly combined and protected from the action of the air by being converted into a granular form by means of sugar. Certain of these are official. Although very convenient, they are apt to lose their effervescent property to some extent unless tightly corked, on account of the acid slowly decomposing the carbonate, but, aside from the loss of the effect of the carbonic-acid gas, they are as efficient when stale as when fresh.

When it is desired to make an effervescing draught extemporaneously it may be prepared by combining 20 grains of sodium or potassium bicarbonate with a scant half ounce of lemon-juice or about 10 grains of citric acid or 15 grains of tartaric acid. As a rule, the amount of water used should be not over half a pint, somewhat less for children, and the draughts may be flavoured with some syrup. The addition of a little gelatin or gum arabic will make the mixture rather more agreeable to most persons, more particularly to children, as the bubbles are more persistent and the drink will resemble "soda water." With an effervescing draught castor oil may be combined provided it is well emulsified by gum or gelatin and mixed while the effervescence is at its height. At the present time the use of this class of preparations is too general, as those containing potassium bromide, caffeine, and lithium salts are dispensed indiscriminately and often in too large amounts. Moderate amounts administered at proper times are entirely harmless, but the habitual use of considerable quantities of the alkaline citrates or tartrates is not without more or less influence upon the digestion. As might be expected from their composition, nearly all of these preparations are laxative, diuretic, and in febrile conditions refrigerant, and they are particularly grateful vehicles for the administration of almost any soluble salt when there is an irritable condition of the stomach. In a measure, the good effect of the various proprietary effervescent preparations containing potassium bromide or caffeine, or both, so largely used for the relief of *headache* and the unpleasant results of *excesses in eating or drinking*, is due to the carbonic-acid gas, as the amounts of the salts present are relatively small, and also to their slight laxative effects. As the granular preparations are generally taken before complete solution has occurred, considerable of the carbonic-acid gas is evolved in the stomach.

The best-known member of this group is the compound effervescing powder, or Seidlitz powder, *pulvis effervescens compositus* (U. S. Ph., Br. Ph.), *pulvis aerophorus laxans* (Ger. Ph.), *pulvis effervescens seidlitzensis* (Austr. Ph.), *poudre gazogène laxative* (*pulvis effervescens laxativus* [Fr. Cod.]), which depends for its action almost exclusively upon the Rochelle salt that it con-

tains. The U. S. Ph. also authorizes an effervescent citrated caffeine (*caffeina citrata effervescens*), effervescent lithium citrate (*lithii citras effervescens*), and effervescent potassium citrate (*potassii citras effervescens*), all of which are granular preparations.

The *liquor potassii citratis* of the U. S. Ph., or solution of potassium citrate, neutral mixture, saline mixture, or effervescing draught, is only slightly effervescent and should be made extemporaneously by combining 10 parts of lemon-juice with 1 part of potassium carbonate or 1½ of the bicarbonate. Solution of magnesium citrate, *liquor magnesii citratis* (U. S. Ph., Br. Ph.), *magnesium citricum effervescens* (Ger. Ph., Austr. Ph.), is largely used, both for its laxative properties and for the carbonic-acid gas it evolves in the stomach.

The Br. Ph. authorizes, in addition, an effervescing solution of lithia (*liquor lithiæ effervescens*), an effervescing solution of potash or potash water (*liquor potassæ effervescens*), an effervescing sulphate of sodium (*sodii sulphas effervescens*), effervescing Epsom salt or sulphate of magnesium (*magnesii sulphas effervescens*), effervescing phosphate of sodium (*sodii phosphas effervescens*), effervescing citro-tartrate of sodium (*sodii citro-tartras effervescens*), and an effervescing solution of soda (*liquor sodæ effervescens*).

The *pulvis aerophorus* of the Ger. Ph. and that of the Austr. Ph. are the same, consisting of sodium bicarbonate and tartaric acid. They are used when a carbonated, slightly laxative potion is required and as a vehicle.

Unofficial preparations of potassium bromide, either alone or with caffeine citrate, and those of caffeine citrate alone, are found in all apothecaries' shops and in many bar-rooms, etc. They may be taken in doses of a heaped teaspoonful, which represents about 10 grains of potassium bromide, with or without a grain of caffeine citrate or a grain of the latter only. Effervescent artificial Carlsbad (Sprudel) salt, when dissolved in the proportion of about 15 grains to the ounce of water, is a fair substitute for the natural water; the Vichy (grand Grille) and Kissingen (Ragaczy) are also imitated, to the latter small amounts of lithium carbonate being sometimes added. Besides innumerable preparations in imitation of the various mineral waters, there are many containing the soluble salts of iron, etc., which are often used but are of no particular value.

Russell H. Nevins.

EGGS.—The eggs used in pharmacy are those of *Gallus Bankiva*, the common domestic fowl. The liquid white of the egg, *ovi albumen* (Br. Ph.), and the yolk, *vitellus* (U. S. Ph.), *ovi vitellus* (Br. Ph.), are official. The shell of the egg consists of calcium carbonate, animal matter, calcium phosphate, ferric oxide, magnesium carbonate, and sulphur; when it is exposed to a high degree of heat the carbonic acid is dissociated from its compounds, the animal matter is consumed, and almost pure lime remains. The latter has been given in doses of from 5 to 10 grains as an antacid in *diarrhœa*.

The white of egg is used to clarify liquids, as it catches undissolved particles. It has been used to suspend insoluble substances in water. Mixed with alum, it forms alum curd (see under Alum). It is administered as an antidote in poisoning by corrosive sublimate or copper sulphate, as it forms insoluble inert compounds with these salts. But an emetic should be given immediately after the albumen because the albuminates are soluble in gastric juice.

The yolk is odourless, possesses a bland oily taste, forms an emulsion when mixed with water, and is coagulated by heat. The yolk is easily digested and has been given, beaten up raw with water and tincture of ginger, for *dyspepsia*.

Eggs, like milk, constitute an almost complete food, as they contain all the elements of the blood. Bauer found that the mean weight of the hen's egg was 750 grains; of this 105 grains are shell, 405 grains are albumin, and 240 grains are yolk. Dr. Pavy calculated that an egg weighing 2 oz. would contain 110 grains of nitrogenous substances, 82 grains of fat, and 11 grains of saline matter; the white, which consists chiefly of albumin dissolved in water, contains the larger proportion of nitrogenous substance, and the yolk the greater quantity of fat.

Eggs are particularly useful in medicine as articles of diet, or reconstructives. They may be administered, when well beaten up, by the mouth or by the rectum; and it is sometimes necessary, especially when they are given in enemata, to add a little pepsin or pancreatin to facilitate their digestion.

As a food in febrile maladies an egg may be beaten up in warm water and the mixture strained and added to a little clear broth.

An excellent and nutritious restorative in *anæmia*, with *loss of appetite* and *cardiac feebleness*, is Dr. I. Burney Yeo's mixture of the yolks of one or two eggs beaten up with boiling water, with or without milk, to which a little sugar, nutmeg, or other spice and a tablespoonful of brandy are added.

In conditions of *nervous exhaustion* with loss of appetite an egg beaten up with hot coffee, or an egg beaten up with some aromatic syrup, a few drops of phosphoric acid, and added to a little cold carbonated Seltzer or Vichy, is an excellent stimulant. The latter mixture will be found of great use, given during the morning and afternoon, in conditions of *malnutrition* such as that of *incipient phthisis*.

The *mistura spiritus vini gallici* (Br. Ph.), egg brandy, is prepared by rubbing up the yolk of an egg with ¼ oz. of powdered white sugar, then adding to the mixture 2 fl. oz. each of brandy and of cinnamon water, and beating all these ingredients together. This is an agreeable tonic and food in all exhausted conditions.

A hot mixture composed of wine or spirit, sugar, beaten eggs, and nutmeg and ginger, is called egg flip and is a useful stimulant in *asthenic conditions*.

Lait de poule is made by beating up the

yolk of the egg in hot water and adding sugar and some aromatic flavouring substance, such as cinnamon or orange-flower water, or brandy or rum. This is an agreeable stimulant.

A mixture of half a pint of new fresh milk, the yolk of an egg, a teaspoonful of powdered sugar, a little nutmeg or cinnamon, and a tablespoonful of rum, beaten together and taken early in the morning, will prevent, it is said, the *exhausting sweats* that accompany the morning sleep of those affected with *tuberculosis*. Egg lemonade, a useful drink in *sore throat*, is made by mixing thoroughly the white of an egg, a teaspoonful of powdered sugar, the juice of a lemon, and a glass of water.

Caudle is made by beating up a raw fresh egg with a wineglassful of sherry wine, and adding to it half a pint of hot oatmeal, gruel, or farina. It may be sweetened and flavoured with lemon or nutmeg.

Egg broth is made by adding 2 oz. of pearl sago to ½ pint of cold water, allowing it to stand for half an hour, then boiling it until it is moderately thick and smooth. The yolks of 4 eggs are beaten with ½ pint of cream, then mixed with the sago, and the whole stirred well in a quart of hot beef-tea or chicken broth.

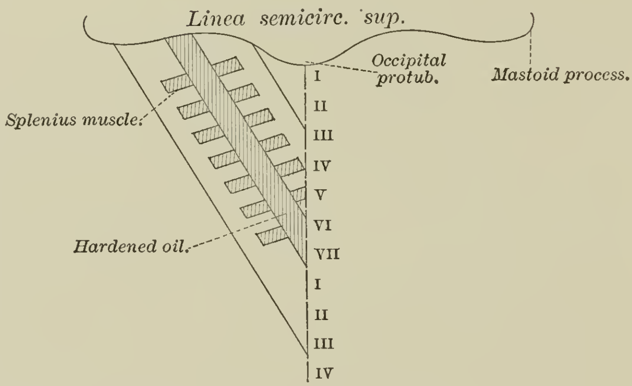
Dr. George Thomas Jackson recommends a shampoo composed of the yolk of an egg beaten up in lime-water, as a useful remedy for *dandruff*. As a *hair wash* he advises the yolks of 3 eggs beaten up in a pint of lime-water. *Glyceritum vitelli* (U. S. Ph.), made by mixing 45 parts of the yolk of eggs with 55 of glycerin, makes a good hair wash.

SAMUEL T. ARMSTRONG.

ELÆOMYENCHYSIS.—This procedure, first described by me in the *New York Medical Journal* for April 14, 1894, consists in the injection of oils into muscles affected by local spasm and their congelation there. The object which it is thereby sought to obtain is the curtailment of the activity of the contractile substance of the organ by mechanical interference and limitation of nutrition. I have employed this mode of treatment successfully in a number of cases of *spasm*, and notably in those forms of *torticollis* where the convulsive condition is largely restricted to the splenius muscle.

A non-irritating oil like cacao butter is best suited to the purpose; it should be combined with a sufficient quantity of paraffin to elevate the point of solidification somewhat above the normal blood temperature. The injections may be conducted by the aid of a large glass syringe, armed with a stout hypodermic needle, in the following manner:

In the first place they should be made while the muscle is extended as much as possible, so that the fat deposited may interfere most effectually with the contraction of the organ. To accomplish this, I do not hesitate to etherize the patient; but this is unnecessary in the case of clonic convulsions and probably urgently demanded only where we are confronted with severe tonic spasm. A second important point is to distribute the oil with regularity throughout the affected muscle, beginning at the origin and continuing the injections till one or more zones of considerable thickness extend to the insertion of the muscle. Moderate massage of the injected parts will greatly facilitate this part of the operation. The transverse injections may then be undertaken in the manner shown in the accompanying cut. It is necessary to employ a hypodermic needle of ample



lumen, as the hot and heavy oil is apt to congeal in the small needles conventionally employed for purposes of hypodermic medication. The syringe, too, should be at least two hundred minims capacity; must be heated to 110° F. before being filled; and, with its needle attached, should be kept in hot water of a like temperature till the very moment of making the first injection. Should the oil, in spite of these precautions, congeal in the needle, dipping the latter into hot water will at once clear the lumen. It is well not to attempt to accomplish too much at one sitting, but to rely upon supplementary injections undertaken at intervals of three or four days. It must not be forgotten, however, that, in order to insure success, a large quantity of oil must ultimately be injected. Should there be some local soreness after the operation, the ice-bag may be kept in place over the muscle for a few hours. As a rule, however, it should be replaced as soon as possible by a bag of moderately warm water, which often proves most comforting, and tends to cause relaxation of the organ. I once completely arrested the growth of a small tumour which was pressing upon the supra-orbital nerve and giving rise to considerable pain, by injecting oil into and in the vicinity of the neoplasm, and congealing it permanently by cold. The relief from pain also was permanent.—J. LEONARD CORNING.

ELÆOSACCHARA (Ger. Ph.), *oleosacchara* (Nat. Form.), *oléosaccharures* (Fr. Cod.), oil-sugars, are triturations of volatile oils with sugar. The ones most commonly employed are those of anise, cinnamon, lemon, and peppermint. They are used mainly to disguise the taste of ill-flavoured powders and as corrigents, that of cinnamon being frequently employed with bismuth. The Ger. Ph. prescribes that they shall be compounded of 1 gramme of a volatile oil to 50 grammes of powdered sugar, while the Nat. Form. directs that they shall contain 1 drop of any volatile oil to 30 grains of sugar. The proportions, therefore, in both cases are about the same. The trituration should be continued until a fine powder results. Elæosacchara should be freshly prepared when required. In the cases of *elæosaccharum anisi*, *elæosaccharum fœniculi*, and *elæosaccharum menthæ piperitæ* the Nat. Form. directs that the corresponding essential oils shall be used in the proportions given. Elæosacchara are but little used in the United States.—Henry A. Griffin.

ELASTICA (U. S. Ph.).—See Rubber.

ELATERIN, *elaterinum* (U. S. Ph., Br. Ph.), is the active principle of elaterium, in which it occurs in amounts varying from 5 to over 40 per cent. Its formula is $C_{20}H_{28}O_5$. Chemically it is a neutral substance and appears as small colourless crystals without odour, but of a bitter and acrid taste. It is permanent in the air, practically insoluble in water, only slightly soluble in alcohol, and very slightly soluble in ether. It is, however, freely soluble in chloroform. It may be obtained by boiling elaterium with alcohol and treating the filtrate with potash, but the method of the Br. Ph. is to be preferred. By this elaterium is exhausted with chloroform, ether is added to this solution, and the precipitate is washed with ether and purified by recrystallization from chloroform. Elaterin was made official because of the great variation in strength of various specimens of commercial elaterium, but it is itself liable to be found adulterated. The actions and uses of elaterin are the same as those of elaterium, its chief employment being as a hydragogue cathartic, useful especially for the relief of *dropsies*, and its chief contra-indications being debility and gastro-intestinal irritation and inflammation.

Elaterin is to be given preferably in pill. The dose, according to the Br. Ph., is from $\frac{1}{40}$ to $\frac{1}{10}$ of a grain, but for a beginning dose $\frac{1}{20}$ of a grain should not be exceeded. The trituration of elaterin, *trituratio elaterini* (U. S. Ph.), contains 1 part of elaterin and 9 parts of sugar of milk. The dose is from $\frac{1}{2}$ to $\frac{5}{8}$ of a grain. The compound powder of elaterin, *pulvis elaterini compositus* (Br. Ph.), is also a trituration; it contains 1 part of elaterin and 39 parts of sugar of milk. The dose, according to the Br. Ph., is from $\frac{1}{2}$ to 5 grains, but the latter dose is certainly excessive.

Henry A. Griffin.

ELATERIUM (Br. Ph.), so-called *extractum elaterii*, is a sediment deposited from the juice of the fruit of the squirting cucumber, *Ecballium Elaterium*, a vine which grows wild in the Mediterranean regions of Europe, Asia, and Africa, but is cultivated elsewhere. Its active principle is elaterin, a neutral substance. The fruit of cultivated British plants is known as *ecballii fructus* (Br. Ph.). The fruit resembles a small cucumber, is about $1\frac{1}{2}$ inch in length, 1 inch thick, and covered with prickles. Its colour is grayish-green. When ripe, the fruit separates itself from its stem, and through an opening thus created the internal pressure forces out the juice and the seeds in a stream. In preparing elaterium the fruit, when nearly ripe, is cut longitudinally and gently pressed, and the juice is passed through a hair sieve. This juice is then set aside to deposit, and though as it flows from the fruit it is perfectly colourless, it soon becomes turbid and in the course of a few hours the formation of a sediment is begun. When the settling is completed the supernatant fluid is carefully poured off and the sediment is collected on a linen filter and dried on porous tiles and in a warm place. This sediment is elaterium, which, when dried, appears in friable cakes about $\frac{1}{10}$ of an inch in thickness and of a pale-green, grayish-green, or grayish-yellow colour, the yellow tinge being generally an indication of a greater age. Its odour is faint and its taste bitter and acrid. Inferior qualities of elaterium are often darker in colour and harder and more resinous in consistence. The amount of elaterium contained in the fruit is very small, and for this reason adulteration is not infrequent. For the same reason the juice is sometimes expressed with much force, so that, though a greater amount of the product is thus obtained, it is a product of inferior quality, for the parts of the fruit other than the juice are relatively if not actually inert. It is said, too, that the juice is sometimes evaporated, that the product may be more abundant, instead of taking the sediment of the juice only. The "extract" which results from this evaporation is certainly an inferior preparation, for the juice when deprived of its deposited elaterium is relatively inactive. The activity of elaterium therefore varies greatly with the preparation, some specimens of elaterium having yielded not more than 5 or 6 per cent. of elaterin, while others have yielded over 40 per cent. According to the Br. Ph. the proportion of elaterin contained in elaterium should not be less than 20 per cent. From these reasons it will be seen that elaterium is a drug of uncertain strength and in no way comparable in certainty and in safety to its active principle, elaterin; nevertheless elaterium itself is much used.

Elaterium is irritating when locally applied, and, being absorbed, may cause purgation. Its external application, however, is not made use of. Given by the mouth, it excites to some degree the flow of saliva and leaves in the mouth a persistent bitter taste. Some diuretic powers have been said to reside in elaterium, but they are certainly not prominent and its chief medicinal virtues are manifested in the production of energetic hydragogue catharsis.

Properly administered and in sufficient doses, it causes large watery evacuations from the bowels, and this without undue pain or evidence of gastric or intestinal irritation. For these reasons elaterium is rated as one of the most valuable hydragogue purges we possess, if not the most valuable. Its use, however, may be accompanied and followed by so much prostration and even exhaustion as to require the administration of stimulants and the employment of other supporting measures. From doses too large there result nausea, vomiting, hypercatharsis, and exhaustion, and the use of the remedy may be and has been followed by a fatal result from violent gastro-enteritis. Elaterium, therefore, though a drug of great value, is not one to be used without much care and discrimination.

The therapeutical applications of elaterium are indicated by what has already been said, and comprise those conditions in which fluid depletion is demanded. In *ascites* and in *dropsies* in general we have the conditions most appropriately treated with it and most benefited by it. *Liquid effusions* resulting from inflammation, as in *pleurisy* and *pericarditis*, may also thus be treated, but means so energetic are seldom required. *Uræmia* is also much benefited by elaterium, probably, as has been said, because elimination of the uræmic poison is thus effected through the bowels. Elaterium may be used as a revulsive and depleting agent in *cerebral affections*, especially *congestions*. In all conditions of debility the use of elaterium must be cautious in the extreme, and if debility is pronounced the drug should not be employed. The giving of elaterium to the aged is therefore not to be recommended, and in the presence of gastric or intestinal irritation and inflammation the drug should be absolutely withheld.

Though elaterium may be effective to purge if given subcutaneously, it is, when so given, productive of severe local irritation and inflammation, and the administration of the remedy by any channel other than the mouth should not be attempted. The fact that the strength of elaterium is not constant makes the determination of its dose difficult. Though larger doses may be borne, it will be wiser, because of its dangerous activity as a poison and the number of deaths it has caused, to begin with a dose of $\frac{1}{8}$ or $\frac{1}{6}$ of a grain, which may be repeated hourly until it is effective. A preparation much used is Clutterbuck's elaterium, of which the dose is $\frac{1}{8}$ of a grain. The similarity in appearance of the names elaterium and elaterinum makes necessary a precaution on the part of the prescriber that confusion shall not occur, for the difference between the two drugs in strength is such that the substitution of one for the other might, on the one hand, be productive of disappointment and, on the other, give rise to a dangerous result.—Henry A. Griffin.

ELECTRICITY. — **Galvanism.** — Upon immersing two elements of a certain series in liquid, electro-motive force (E M F or E) is developed. This series consists of carbon, platinum, gold, silver, copper, iron, tin, and zinc. The farther apart the elements selected from this series, the greater the amount of electro-motive force developed. Zinc, as the most positive metal, is chosen for one of the pair in almost every cell in medical use, and carbon, silver, or copper for the negative elements.

The current begins to flow when the ends of the two elements outside of the liquid are connected by a piece of wire. A circuit is then formed. The zinc, though the positive metal, carries the negative pole (cathode, known by the sign —). The copper, though the negative metal, carries the positive pole (anode, known by the sign +). The electric current (called variously continuous, constant, voltaic, or galvanic current) flows in a circle or circuit, always in one direction, from the positive pole, or anode, to the negative pole, or cathode, from the positive to the negative element. Electricity is a form of molecular motion. We may best compare it to a stream flowing in one direction.

The unit of measurement of electro-motive force is termed a volt. The Daniell cell (zinc and copper), yielding 1·08 volt of electro-motive force, is adopted as a standard of comparison. Thus, the chloride-of-silver cell (zinc and silver) yields 1, the Leclanché cell (zinc, carbon, and chloride of ammonium) 1·8, and the Grenet (zinc, carbon, and dilute sulphuric acid) 2 volts.

Resistance.—The current developed in a cell meets with resistance (R) in flowing, just like water flowing through different sizes of pipes or over rocky beds in a stream. There is a resistance inside of the cell itself to the current flowing from the zinc to the negative metal, due to the liquid and sometimes a porous cylinder through which it must pass. The greater resistance is usually, however, external to the cell, in the wires or other conducting bodies connecting the two elements. This external resistance depends upon the molecular properties, length, and transverse sectional area of the substance through which the electro-motive force must vibrate. Thus, a copper wire presents but a modicum of resistance to the current, while an iron wire of the same dimension gives six times as much, German silver twelve times as much, a concentrated solution of salt six and a half million times as much, and animal tissues a million times as much. The greater the transverse sectional area of the conductor, the less will be the resistance, for the latter is inversely proportional to the diameter. This explains why large electrodes offer less resistance to the current than small ones when applied to the human body.

The unit of measurement of resistance is called an ohm. One ohm is the amount of resistance to the current in a coil of copper wire 1 millimetre in diameter and 48·5 metres long. The legal ohm (Paris Congress, 1884) is the resistance of a column of pure mercury 1 square millimetre in sectional area, and 106 millimetres long at the temperature of melting ice.

Current Strength.—It is clear that the actual strength of the current is directly in propor-

tion to the amount of electro-motive force, while, as the current is diminished by the obstruction met with in flowing, the current strength must be indirectly proportional to the resistance. Stated more explicitly, the current strength is the result of the electro-motive force divided by the resistance. This is Ohm's law. Thus:

$$\frac{\text{Electro-motive force}}{\text{resistance}} = \text{current strength, or,}$$

concisely, $\frac{E}{R} = CS$. The unit of measurement of current strength is known as the ampère. Hence, substituting the names of the units of measurement of electro-motive force, resistance and current strength, for the formula $\frac{E}{R} = CS$ we have $\frac{1 \text{ volt}}{1 \text{ ohm}} = 1$ ampère.

Constancy of Cells.—The electro-motive force of a cell diminishes as the zinc is dissolved, and new chemical salts formed in the cell increase the internal resistance. Accordingly the cell grows weaker in course of time. That part of the current which is in the cell decomposes the water of the cell, and hydrogen collects in bubbles upon the negative and oxygen upon the positive element, the former in greater quantity than the latter. An opposing current is set up from the hydrogen to the oxygen, and this may become so strong as to overwhelm completely the current passing from the positive to the negative metal. This phenomenon is termed polarization. Therefore some substance is added to the contents of the cell which, by combining chemically with the hydrogen, will prevent the neutralization of the current in this way. In the Daniell cell sulphate of copper is the depolarizing agent; in the Leclanché, peroxide of manganese; in the silver, chloride of silver; in the Grenet, bichromate of potassium. The acids added to the liquid of some cells and the chloride of ammonium in the Leclanché are known as excitants.

Arrangement of Cells in a Battery.—When all the zincs are combined to form one pole and all the carbons joined together to form the other, the cells are said to be arrranged simply (or in multiple arc); when united zinc to carbon throughout, the arrangement is termed compound (or in series). The current strength obtained varies with the kind of arrangement employed. In the former case the electro-motive force is the same as in one enormous cell, with the internal resistance diminished by the larger area of elements; in the latter the electro-motive force is multiplied by the number of cells, but the internal resistance of each cell must also be multiplied by the number of cells. The simple arrangement is generally used in batteries which are to supply light and heat for illumination and for the galvano-cautery. The compound arrangement is that of most office batteries employed for neurological and gynæcological purposes.

Faradaism.—If a wire is placed parallel to, but not in contact with, a wire through which a galvanic current is passing, a current is set up, or induced, in this second wire flowing in the opposite direction. When the battery circuit is broken the reverse takes place. So that if we make and break the circuit of the battery current by means of a key there will be a to-and-fro, or alternating, current in the isolated wire.

If the wire is in the shape of a coil, the various coils are evidently parallel to each other, and the same phenomenon of induction takes place in this coil as in the separate wire. Then if the independent or secondary wire is also coiled about the primary coil, a secondary current is induced in it as before. Furthermore, soft iron is magnetized and demagnetized by the making and breaking of a current passing near it. These are the guiding principles in the construction of faradaic batteries. One or two cells furnish the electro-motive force for the primary coil, which is a short, thick wire wound around a bundle of iron rods. The spring-hammer automatically breaks and makes the current by the magnetization and demagnetization of the bundle of iron rods.

The secondary independent wire is long and thin and is coiled about the primary wire, but is made to slide over it so that the current may be increased or decreased by exposing a greater or smaller extent of the coil to the action of the battery. Every turn of the coil multiplies the electro-motive force of the faradaic battery. Although the voltage of the cell used may not be above two volts, and by itself yield an imperceptible galvanic current, the electro-motive force is enormously increased by the use of the wire coils.

It is to be borne in mind that both the primary and secondary currents are to-and-fro, or alternating, currents. There is no difference in the action of the primary and secondary current upon muscles, except that the fineness and length of the secondary wire seem to produce a current of higher tension—one more painful. Evidently, too, there can be no practical difference between the poles in an alternating current.

The Alternating Sinusoidal Current.—Quite recently the alternating current has been made use of in medicine, particularly by the French. The vibrations of the to-and-fro current are made so rapid that the stimulating effect upon muscles and sensory nerves are got rid of, so that this current, known as the sinusoidal, does not cause painful contractions in the parts treated. While not enough testimony has been accumulated as to the value of this form of electricity in medicine to give it as yet great vogue, it is alleged for it that it is sedative to the nervous system, diminishes secretions, and, when employed with large electrodes or in a bath, is particularly stimulating to trophic processes.

Static Electricity.—Static or frictional electricity is obtained by the rubbing of glass or vulcanite with fur or paper. The physics need not be discussed here. The fact that electricity can be so produced is taken advantage of in the construction of what are known as static machines. Most of them have large revolving discs of glass. One made by Her-

man Glaser, of Vienna, is very efficient, and having, as it does, hermetically sealed hard-rubber cylinders in place of glass discs, it is not effected by humidity of the atmosphere.

There is much discussion among eminent physicians as to the actual usefulness of static electricity in medicine. It seems quite certain, however, that it has no advantage over galvanism and faradaism, save perhaps in point of the strong mental impression it is apt to make. Its value for purposes of suggestion would seem to be superior to that of the other forms. It contracts muscles in the same manner as galvanism and faradaism do by stimulating the nerve filaments, and other effects, such as the electrolytic and cataphoretic, may also be produced, though to a limited extent.

The Electro-magnet.—Magnets have no effect whatever upon the human body—upon protoplasm, upon the iron in the blood, upon ciliary movements, upon the circulation, or upon the nervous system or any of its functions. A magnet made of wood would be as efficacious in disease as one made of iron. The only value of the electro-magnet is to the oculist, for removing small particles of iron imbedded in the eyeball. Mr. Kennelly and I have demonstrated these facts at the Edison Laboratory with the most powerful magnets in the world (*N. Y. Med. Jour.*, Dec. 31, 1892).

Galvanic and Faradaic Apparatus.—It would be difficult, and indeed needless, to enumerate here the great number of electrical appliances manufactured nowadays for medical and surgical purposes. I mention the batteries I think to be the best and the supplementary apparatus I have found to be most necessary.

Barrett's chloride-of-silver battery is the best galvanic battery as regards portability. It is so small that a 50-cell battery weighs but six pounds. It has the further advantage of running for two years or more without requiring repair or replenishing of any sort. It is dry, so that rough handling does it no harm. It is strong enough for neurological therapeutics and for electro-diagnosis, but not altogether strong enough for surgical and gynæcological purposes.

For stationary office batteries, the Leclanché cell is the most satisfactory, requiring as it does only very occasional replenishing or repair. Sixty cells will furnish sufficient electro-motive force for any purpose. A faradaic apparatus is generally combined with it, so that both are at ready command. Batteries composed of these cells are manufactured by almost every firm dealing in medical electrical supplies.

For an independent portable faradaic battery, the one with a single Leclanché cell, manufactured by John A. Vetter, of New York, has seemed to me to be most satisfactory for neurological purposes, electro-diagnosis, etc.

I have recently had made for me (see *N. Y. Med. Jour.*, Aug. 20, 1892) by H. E. Stammers, of No. 1464 Broadway, New York, probably the smallest faradaic battery in existence. It is powerful and can easily be carried in a hand bag or in the pocket.

Some of the Principal Cells employed.

Name of cell.	Positive element	Negative element.	Exciting agent.	Depolarizing agent.	Voltage.
Daniell....	Zinc.	Copper.	Sulphate of zinc.	Sulphate of copper.	1·079
Chloride of silver.	Zinc.	Silver.	Chloride of zinc.	Chloride of silver.	1·02
Bunsen....	Zinc.	Graphite.	Acid sulph. dil.	Nitric acid.	1·80
Leclanché.	Zinc.	Graphite.	Ammon.	Mangan. diox.	1·60
Grove.....	Zinc.	Platinum.	Acid sulph. dil.	Acid nitric.	1·96

The Rheostat and Galvanometer.—Besides the usual complement of dial, current reverser, rheophores, electrodes, etc., the galvanic battery should be provided with a rheostat of some kind for accurate graduation of the current strength, and a galvanometer, or milliampèremeter, for the measurement of current strength. Where it is desirable to measure the amount of resistance of the body, a wire-coil rheostat, each coil being marked with its definite number of ohms, is most useful, but, as this is no desideratum to the general practitioner, a water rheostat or a graphite or carbon rheostat will best serve his purposes. In the first the current is made to pass through a column of water in a glass cylinder. The nearer the metallic ends of the cylinder are made to approach each other, the less becomes the resistance. There is a sliding piston rod, connected with one pole, to attain this object. By the use of rheostats very fine graduation of the current strength is possible, and interruptions of the current and sudden increase or decrease of its strength are avoided. This is very essential in most gynæcological applications and in treatment of the eyes, head, etc., with the galvanic current.

A galvanometer, an instrument devised to measure current strength, is an important requisite in a physician's electrical armamentarium. Most galvanometers are constructed upon the principle that a magnetic needle is deflected by a current of electricity flowing in its neighbourhood, and in direct proportion to the strength of the current. This can be seen by winding a wire around an ordinary compass and passing a current through the wire. But in the galvanometer an ordinary magnetic needle would not be perfectly accurate, owing to its tendency to turn toward the north. Hence an astatic needle is used in the medical galvanometer, and it moves upon a dial marked with the units of measurement of current strength. One ampère is a stronger current than is ever used by physicians, and hence our galvanometers are graduated to measure milliampères (or thousandths of an ampère). In neurological cases it is rare to employ a current strength of more than 25 milliampères, but in gynæcological practice currents of from 25 to 500 milliampères are required. The best instrument is the absolute galvanometer manufactured by Hirschman, of Berlin; but there are very good ones made in this country by John A. Barrett, of Baltimore, by Waite & Bartlett, of New York, and by others.

Rheophores and Electrodes.—The conducting cords, or rheophores, should be flexible and not easily broken. Good rheophores may now be obtained from any of the firms mentioned. The poles, or electrodes, to be attached to the cords for electrical applications will be mentioned under therapeutical headings.

The Resistance of the Human Body.—The chief resistance is in the skin, for the other structures (bones, viscera, muscles, etc.) are so saturated with the blood (a saline fluid) that they offer a comparatively small resistance to the current (averaging 700 ohms). The degree of resistance in the skin depends upon its thickness, its dryness, the number of sweat ducts, the strength of the current, and the size of the electrodes placed upon it. This resistance is therefore not a fixed quantity. It varies within such wide extremes, not only in different persons and in different parts of the same individual, but in the same places at different hours, and it depends so much upon the strength and continuance of the current and upon the area of the electrodes that no absolute number of ohms can be given as the amount of resistance in an animal body.

The longer the current passes, the more does resistance diminish. The stronger the current used, the more rapid is the fall of resistance. This is because of the dilatation of the capillaries under the poles and the consequent saturation of the skin with a saline fluid. A hot, perspiring skin offers, of course, less resistance than a cold and dry one.

Edison, measuring the resistance of several hundred persons with the hands immersed in a weak solution of caustic potash, found the average resistance to be 1,000 ohms. Jolly, using small currents and small electrodes, noted at times a resistance of 50,000 ohms. But the average resistance of the human body under ordinary conditions may fairly be stated to lie between 2,000 and 4,000 ohms.

In order to measure the resistance of the human body, it is only necessary to first note the number of milliampères of current strength obtained when the current is passing through the body. Then a wire-coil rheostat is substituted for the body, and coil after coil is introduced into the circuit until the number of milliampères corresponds with that previously obtained when the body was in the circuit. Then one reads off the number of ohms marked upon the coils, which of course must be the resistance of the human body as well as that of the rheostat, since the current strength produced by each, as read upon the galvanometer, was the same.

The only practical value of measuring human resistance at present is in the examination of patients afflicted with exophthalmic goître. In this disease, probably owing to the hyperidrosis and superficial capillary dilatation, the resistance, instead of being from 2,000 to 4,000 ohms, is usually much reduced, say to between 1,000 and 2,000 ohms. This diminished resistance, when present, constitutes one of the positive symptoms of the disease, but its absence does not exclude the disorder.

It should also be mentioned that Vigouroux has recently pointed out the occurrence of an increasing resistance above the normal average in certain cases of hysteria. Thus, in hysterical hemianæsthesia the resistance of the anæsthetic side is said to be greater than that of the opposite side. This needs further corroboration.

Diffusion of the Current.—In passing through the body the current does not pass in a straight line from one electrode to the other, but is diffused throughout all the tissues intervening between the poles. This is the reason that the galvanic taste and flash of light are often perceived when the poles are not upon the head but upon the upper part of the trunk.

The Production of Heat and Light.—The fact that electricity may be transformed by the use of proper apparatus into heat and light has been taken advantage of for medical purposes in the construction of the galvano-cautery and a variety of endoscopes. In the former a wire loop is heated to a white heat, and by this means tumours, such as polypus, in the various cavities of the body and the like, may be bloodlessly removed; or platinum points are heated to redness for ordinary cauterizations. By means of the numerous endoscopes now in the hands of the profession, the interiors of the rectum, bladder, stomach, and other cavities may be readily explored with the eye. The ordinary medical currents applied to the body are too weak to produce any thermal effects, as has been demonstrated by careful tests.

Electrolytic Effects.—Electricity produces chemical changes in gases, liquids, or solids lying in its path. Thus, the oxygen of the air is ozonized by lightning. Water is decomposed into hydrogen and oxygen. Salts are divided into their bases and other constituents. Oxygen and oxides collect at the anode; hydrogen, alkalies, and bases at the cathode. When galvanic currents are passed for a long time through the body in considerable strength a caustic action is exercised under both electrodes, while the tissues beneath the anode present an acid, and those beneath the cathode an alkaline reaction. This is electrolysis.

This power of electricity is employed for the dissipation of *tumours* and the destruction of *aneurysms* in various parts of the body, needles being introduced into them, either to decompose the tissues (softening effect with the cathode) or, as in vascular growths and aneurysms, to coagulate the blood (coagulating effect with the anode).

In the *removal of superfluous hairs* a fine needle (cathode) is inserted alongside of the hair down into its root, and a current from five or six cells turned on for a few seconds, until a bubble is seen to rise by the side of the needle and the hair comes away on slight traction with a forceps.

Cataphoretic Effects.—One of the most important properties of the constant current is its power to drive substances before it, so to speak, as it flows from the positive to the negative pole. By careful experiment it has been determined that drugs may be introduced into

the system by this means. Solutions of cocaine, aconitine, morphine, iodine, iodide of potassium, strychnine, corrosive sublimate, menthol, ouabain, helleborin, etc., are placed upon a sponge-covered anode and applied to the skin with an endurable current. In a few minutes they are diffused through the skin into the tissues, producing in the case of the narcotics characteristic local anæsthesias, and in the case of the other drugs the usual effects. If used for a short time the effects are purely local, if continued they may become constitutional. I never make use of electricity now in the treatment of *neuralgias of superficial nerves* without saturating the anode with a 10- to 20-per-cent. solution of cocaine before placing it upon the painful point. Exact dosage is certain by using the metallic cataphoric electrode made for me by Messrs. Waite & Bartlett in 1889. Upon this a disc of paper is placed and the solution applied drop by drop as required. For the uses of cataphoresis in neuralgias, in superficial pains, for small cutaneous operations, in tumours, in rheumatism, in gout, in skin diseases, for mineral baths, and for diagnostic purposes the reader is referred to the following articles by the author: Electric Cataphoresis as a Therapeutic Measure, *N. Y. Med. Jour.*, April 27, 1889; A System of Exact Dosage in the Cataphoretic Use of Drugs, *N. Y. Med. Jour.*, Nov. 15, 1890; A Further Study of Anodal Diffusion as a Therapeutic Agent, *Med. Record*, Jan. 31, 1891; The Introduction of Drugs into the Body by Electricity, *Times and Register*, March 21, 1891; and Bigelow's *International System of Electro-therapeutics*, article Cataphoresis.

Physiological Effects.—Both the faradaic and the galvanic currents, when suddenly made to pass through a normal nerve or muscle, will, if sufficiently strong, produce contraction of the muscle. For instance, if the electrode is placed over the median nerve along the arm, all the muscles supplied by that nerve will be simultaneously contracted. By placing the electrode over each of these muscles they may be contracted singly upon suddenly making the current. We thus come to speak of "motor points." The nerve-trunks may be stimulated at the points where they approach nearest to the surface of the body, and contractions be produced in all the muscles supplied by them; or a special point may be sought out upon each muscle stimulation of which contracts the individual muscle (this muscle point is the place of entrance of the minute nerve-branch destined for the single muscle). Practice upon one's self at home is one of the best methods of learning and remembering their positions. As this is the most perfect means of acquiring a knowledge of the anatomy and functions of the muscular system, it is surprising that teachers do not more generally make use of it in the medical colleges.

Galvanic Electrotonus.—The alteration of irritability in a nerve caused by the passage of the galvanic current is termed electrotonus. There is a difference between the effects of the two poles when the constant current is used. The anode diminishes irritability, inducing a condition known as electrotonus. The cathode increases irritability, causing catelectrotonus. It is because of this peculiarity that the anode is always placed over the painful spot when the continuous current is employed to diminish pain. We therefore call the anode anodyne.

Vaso-motor Effects.—The electric current dilates the blood-vessels and lymphatics, thus increasing the circulation in the part. Intense redness of the skin is produced under both poles, somewhat more under the cathode than beneath the anode. The vascular dilatation lasts a half hour or more after the removal of the electrodes. Undoubtedly this physiological effect has much to do with the acceleration of nutritive changes in the tissues treated.

Refreshing Effects.—All the currents—the galvanic, faradaic, and static, but especially the first-named—have a stimulating effect upon the organism. Muscles and nerves which have been fatigued by over-exercise are quickly refreshed by such application.

Differences between Faradaism and Galvanism.—Having studied some of the effects of the two currents, we are now able to contrast them, and from this comparison draw certain rational principles regarding the medical and surgical applications of electricity.

Faradaism	Galvanism
Stimulates sensory and motor nerves and contracts muscles.	Stimulates nerves and contracts muscles.
Dilates the blood-vessels slightly.	Drives drugs through the skin (cataphoresis).
Refreshes slightly.	Produces light for the illumination of cavities.
No distinction between the poles.	Produces heat for the galvano-cautery.
	Causes chemical decomposition (electrolysis).
	Dilates the capillaries strongly.
	Refreshes nerve and muscle after fatigue.
	The anode soothes irritation, relieves pain, and is hæmostatic (acids collect there).
	The cathode is stimulating and liquefying (alkaline ions).
	Both poles are caustic, although the cathode is more so.
	Nutrition is improved by the current, by the contracting of muscles, by stimulation of trophic tracts and centres, by dilatation of blood-vessels, and by electrolysis and cataphoresis.

Electro-diagnosis.—The value of electricity, especially to the neurologist, as an agent in diagnosis is, I believe, little known or understood outside the ranks of specialists. It would seem, therefore, that a clear and explicit statement of the points and facts of electro-diagnosis would prove valuable to the general medical practitioner. We use electricity to obtain a positive symptom in tetany, exophthalmic goître, and hysteria; to test all of the five senses—taste, smell, sight, hearing, and feeling; to test the cilio-spinal reaction; to determine the situation of a lesion in a facial neuralgia; to localize centres for brain and

spine surgery; and finally, and most commonly, to distinguish paralyses due to lesions in the spino-muscular segment of the motor tract.

Tetany.—A positive symptom of tetany is the increased reaction of the muscles to the galvanic current. Their electrical irritability is so astonishingly great that a current from two cells, or sometimes even from one cell, is sufficient to cause contractions in the muscles. This is one of the cardinal symptoms of tetany.

Exophthalmic Goître.—In this disease the resistance to the galvanic current is greatly diminished, probably owing to the hyperidrosis and superficial capillary dilatation generally manifested. One sponge electrode being placed on the chest and the other on the back, the current is allowed to pass until the galvanometer registers, say, five or ten milliampères. Then a wire-coil rheostat is substituted for the human body, and coil after coil is introduced into the circuit until the number of milliampères corresponds with that previously obtained. Then one reads off the number of ohms marked upon the rheostat, which gives us, naturally, the ohms resistance of the human body. The normal average resistance of the human body may be given as from 2,000 to 4,000 ohms. In exophthalmic goître it is reduced, in a majority of cases, to between 1,000 and 2,000 ohms, or about half. This reduction of resistance is a positive symptom when present; but it has no negative value if not present.

Hysteria.—Vigouroux has recently pointed out that the resistance in hysteria is increased above the average normal resistance. In hysterical hemianæsthesia the resistance on the anæsthetic side is greater than on the opposite side.

Testing the Taste.—This sense may be examined for the galvanic taste by applying the small wire ends of the rheophores closely approximated to different parts of the tongue. A current from one or two cells suffices. A sharp metallic taste, known as the "galvanic taste," is produced. A Steiner electrode, such as is used to stimulate the cortex of the brain, may also be used for this purpose. The "galvanic taste" is absent on the front of the tongue in injury to the chorda tympani, and on the back of the tongue in lesions of the glosso-pharyngeal nerve.

Testing the Smell.—The sense of smell may be tested by wrapping the end of one rheophore well in absorbent cotton saturated with water and inserting it into the nostril to be examined. The other pole may be in the hand. From one to five cells are used. A peculiar phosphoric odour is perceived if the olfactory nerve is intact.

Testing the Sight.—Whenever electrodes are applied to the head, especially in the neighbourhood of the eyes, flashes of light are perceived when the current is made or broken. These are not observed in total blindness. A mild galvanic current is employed. It is a delicate test of the condition of the retina, sometimes showing faint reactions when light has no apparent stimulus.

Testing the Hearing.—If one sponge electrode is placed over the ear and one on the nape of the neck, a sound will be heard, usually of a ringing character, a clang, when the current is made. The loudest sound is made on closure of the cathode. There is also a weak sound with the opening of the anode. There is a galvanic hyperæsthesia in many cases of central disease. This is especially true in insanity with auditory hallucinations. In certain cases there is a change of the formula—a sound heard with the cathodal opening and anodal closure, or even a reversal of the formula.

Cutaneous Anæsthesia.—With the wire brush and a mild faradaic current we may demarcate areas of anæsthesia of the tactile and pain senses.

Cilio-spinal Pupillary Reaction.—By stimulating the skin of the neck with the faradaic brush, under normal conditions, we dilate the pupil on the same side by the reflex through the cilio-spinal centre (in the fourth cervical to the second dorsal segments of the spinal cord). In destruction of this centre, for instance, in Klumpke's paralysis, or in lesion of any part of the reflex path, this reaction is lost.

To determine whether Severe Neuralgia in Superficial Nerves is Peripheral or Central.—A 10- to 20-per-cent. solution of cocaine, on a cataphoric anode, applied with a continuous current to a painful nerve, such as a branch of the trigeminal, will in a few minutes anæsthetize the nerve and relieve the pain if the lesion is beneath or peripheral to the electrode. Thus, an intense infra-orbital neuralgia, if not relieved by cocaine cataphoresis, is probably of central origin, or, perhaps, hysterical in nature, and neurectomy is contra-indicated.

Localizing Cortical Centres in Brain Surgery.—We have here a very important use for the faradaic current, with a Steiner electrode; for, in locating the parts we want to excise, it is essential that we orient ourselves as to the parts we have trephined over. Fortunately, we are able in this way to recognise our surroundings before opening the dura mater, for I have stimulated the cortical centres through the dura in experiments upon monkeys at the laboratory of the College of Physicians and Surgeons, and also upon man in brain operations undertaken at Charity Hospital. It would be of still greater advantage were we able to stimulate centres through the skull, underneath the scalp. I have experimented upon some animals at the Edison Laboratory, in conjunction with Mr. Kennelly, with a variety of currents, to determine this point. We were unable to excite cortical centres through the skull bones after removal of the scalp, but this is not owing to the bone being a bad conductor, as it is generally supposed to be, but because, as we were able definitely to decide, the skull bones are such good conductors that currents are short-circuited and do not reach the brain substance.

Localizing Spinal Centres in Spinal Surgery.—The Steiner electrode, with mild faradaic currents, may be employed with advantage here also, in stimulating and thus localizing

and recognising spinal nerve-roots and segments during operations upon the vertebral canal.

Distinguishing Peripheral Paralyses.—Probably, however, the most useful application of electricity, from a diagnostic point of view, is to distinguish paralyses due to a lesion of the spino-muscular portion of the motor tract from paralyses due to lesions in the central nervous system affecting the cortico-spinal portion of the motor tract. For this purpose both the galvanic and faradaic currents are generally employed, but practically it is usually sufficient to use the faradaic current alone.

Normal Reactions in Nerves and Muscles.—When any current is suddenly applied to the motor point of a nerve or muscle, contraction takes place in the muscle. This is true under normal conditions, and it is also true in any paralysis due to lesion in any part of the spinal cord or brain affecting cortico-spinal motor fibres.

To obtain these reactions, a flat sponge electrode is placed upon any indifferent part of the body, say the back or chest, or in the hand. Another electrode, with an interrupting handle, is then applied to a motor point. In using the faradaic current we need make no distinction between the poles, whether they are negative or positive; the results are precisely the same. The fact is that with the primary current the cathodal contractions are a trifle more powerful than the anodal, while with the secondary there is absolutely no difference, because the secondary current is an alternating current, each pole being first positive, then negative, with the rapid to-and-fro movement of the electric waves. But when the galvanic current is used there is a difference in the amplitude of contraction produced by the two poles. Hence it is important, indeed absolutely necessary, in employing this current, always to distinguish the positive pole or anode from the negative pole or cathode. In normal muscles the cathode produces a stronger contraction than the anode. Having made our interrupting handle on the motor point the cathode, we increase the number of galvanic cells until our closures of the circuit produce a slight contraction. This is called the cathodal-closure contraction (CCC). Now, if the current-reverser is moved, so that the interrupting handle is made the anode, it will be found that the current is not yet strong enough to produce an anodal-closure contraction (AnCC), but the muscle may contract just as the circuit is opened, making an anodal-opening contraction (AnOC). A stronger current gives us the anodal-closure contraction, and with a very strong current we may obtain with the cathode also an opening contraction (COC). Thus, beginning with a weak current and gradually increasing it, we note first a CCC, then in addition AnOC, later AnCC also, and finally, with very strong currents, we have contractions with either pole, both upon opening and upon closing the circuit. It is not necessary, for our purposes, to pay attention to the opening contractions. The "normal formula" for us, practically, is that the cathodal-closure contraction is stronger than the anodal-closure contraction (CCC > AnCC).

Reaction of Degeneration.—Whenever there is degeneration of a nerve and the muscles supplied by it, their reactions to electricity are changed. If the degeneration is very slight, there is still reaction, but usually less than will be found in the normal nerves and muscles of the patient examined, so that we speak of a diminished electrical reaction. This is called a quantitative or modal change, and is not of the greatest value for diagnosis. But where degeneration is marked and typical there is no reaction at all with either the faradaic or the galvanic current when the interrupting handle is placed over the motor nerve. Now, when the electrode is applied to the motor point of each suspected muscle, it is found not to contract at all to faradaism, no matter how strong the current employed. For diagnosis this would be sufficient. Finding that the muscle does not respond to faradaism, we know that the reaction of degeneration is present. Still, if we desire to try also the effects of the galvanic current, we find that the muscle does contract with the galvanic current in spite of not doing so with the faradaic, only there is a reversal of the normal formula, for now the anodal-closure contraction is equal to or markedly stronger than the cathodal-closure contraction (AnCC > CCC).

In a nutshell, then, we may describe the complete reaction of degeneration as follows:

Normal Muscle.	Degenerated Muscle.
Contracts with faradaism.	Does not contract with faradaism.
Contracts with galvanism (CCC > AnCC).	Contracts with galvanism (AnCC > CCC).

But, now, what do we mean by, and where do we find, degeneration? In order to clearly understand this we must describe, briefly, the motor tract. This tract extends from the motor area of the cortex to the muscles, but it has two segments. The one, called the cerebro-spinal segment, consists of the motor cells in the cortex and the long fibres going down from it through the brain and spinal cord into the cells of the anterior horns of the cord. The other segment, the spino-muscular, consists of the large nutritive ganglion cells in the anterior horns of the cord and the fibres passing out therefrom to end in the muscles. This spino-muscular segment governs the nutrition of the muscles, while the upper portion, or cortico-spinal, conveys chiefly voluntary motor impulses. So, if there is a lesion in the latter, the electrical reactions are unchanged. It is only in lesions of the spino-muscular segment that we have nutritive changes, or degeneration, in the nerves and muscles, and resulting therefrom the electrical reaction of degeneration. The value of electricity in the diagnosis of certain paralyses, therefore, lies in its ability to distinguish for us these two kinds, to tell us whether the lesion is in the cortico-spinal or the spino-muscular segment of the motor tract.

Suppose we are called to a case of paralysis. All that it is actually necessary to do is to take with us one of the small portable faradaic bat-

teries already described, and, having tested the reaction of the muscles in the paralyzed members, consult the following table:

Faradaic Reaction Present.	No Faradaic Reaction.
Hemiplegia, or Monoplegia from any cerebral cause, or Lateral sclerosis.	Poliomyelitis. Amyotrophic lateral sclerosis. Progressive muscular atrophy. Multiple neuritis. Lead palsy. Arsenical neuritis. Alcoholic neuritis. Traumatism to nerves.
(The lesion is in the cortico-spinal segment of the motor tract.)	(The lesion is in the spino-muscular segment of the motor tract.)

Exceptions.—Reactions to faradaism are present in joint atrophies and in milder forms and earlier stages of some other peripheral palsies (such as facial and musculospiral at times). They are also present in pseudo-hypertrophic paralysis so long as there are sufficient fibres left in the muscle to contract. In making these tests, always compare the symmetrical halves of the body, and take good note of the exceptions mentioned in the table.

Methods of employing Electricity.

Neurology.—For stimulation of nerves and contractions of muscles interruptions are made with the interrupting handle. When this is too stimulating and it is desired to diffuse the current through a part, an ordinary sponge electrode, without an interrupter, may be used just like a sponge, rubbing it up and down the surface. This is called the *labile method.*

In most applications about the head, eyes, neck, spine, heart, or other delicate organ, and in applications for the relief of pain, interruptions of the current are not desirable. The *stabile method* is then used—*i. e.*, the cathode being on some indifferent part, the anode is fixed over the seat of pain or over the spot requiring a sedative. Then the current is gradually turned on and, without interruption of any kind, raised to the strength required, and as gradually reduced after a few minutes.

Where it is desired to stimulate nutrition in a part, the galvanic current, of course, is used, and it is important and desirable to employ much larger electrodes than we are accustomed to use for this purpose. Thus, if it is wished to improve the nutrition in a leg affected by *poliomyelitis*, electrodes a foot or so in diameter should be applied to the atrophied parts, and not the small-sized instruments we are so prone to employ. Better even than the electrodes of larger area would be the immersion of the affected extremity in a water-bath, the water being made the anode or cathode as might seem most indicated. If this is adopted more generally we shall be in the future better rewarded for our efforts in such cases, and proof of the nutritive efficacy of the current will be abundantly presented. The roller electrode is very useful for this purpose.

In many works on electricity much is said about directional methods, the employment of ascending and descending currents upon the spine for instance. The terms ascending and descending are quite useless. If the physician remembers merely the polar differences of the galvanic current his common sense will teach him where the electrodes are to be placed.

General Faradization and Galvanization.—Either of these may be accomplished by placing the electrodes in a wooden bath-tub divided into two compartments by a rubber diaphragm containing an opening for the trunk of the body, or by having the patient sit upon or place his feet upon a large sponge electrode or insert his feet into a foot-bath connected with one pole, the other pole being used to sponge the entire body and limbs. This method appeals chiefly to the mind by suggestion, and is therefore useful in the *neuro-psychoses.* It has also probably some value because of its refreshing effects, and with the galvanic current it may be used for the introduction of certain drugs, such as iodide of potassium and corrosive sublimate. As a rule, from five to fifteen minutes' application three times a week or daily is the length of time for employment in most neurological conditions.

Special Electro-therapeutics in Neurology.

Motor Disorders.—We may treat *paralysis* and *spasm* by electricity. In paralysis the distinction between the two classes of disorders by the situation of the lesion in the cerebro-spinal or the spino-muscular segment of the motor tract is to be remembered. Since in the former the nerves and muscles react to faradaism and suffer no trophic disturbance, the indication for electricity is almost entirely to assist in the prevention of spasmodic contractures. Hence the exercise of the rigid muscles by faradaism is useful. The other form of paralysis, which we may call peripheral, requires faradaism if the affection is so mild that the muscles still react to this current. Galvanism is also useful in addition because of its nutritive effects upon the partly degenerated nerve and muscle. If, however, the peripheral paralysis is severe, faradaism is of no value, since the muscles can not be exercised by it, and it has little or no effect upon nutrition. Here galvanism should be used, not only for its value as a trophic agent, but also to exercise and strengthen the muscles by producing contractions.

Clonic spasm, such as *tic convulsif* and *blepharospasm*, may occasionally be improved by the use of the anode (best conjoined with cocaine by cataphoresis) over the affected muscles and nerves, the cathode being placed upon any remote part of the body, like the hand, back, or breast.

Tonic spasm, such as *torticollis* and *writer's cramp*, may also be relieved to some degree by anodal galvanization. In any form of spasm usually only the most recent cases are susceptible of mitigation or cure by electricity. In *hysterical paralysis* or *spasm* strong faradization and static electricity are of great value.

Sensory Disorders.—An irritation or destructive lesion of any part of the sensory tract, from the cortex to the peripheral filaments,

produces in the one case hyperæsthesia (pain, neuralgia) and in the other anæsthesia. *Pain* and *neuralgia* require anodal galvanization, and in pains or neuralgias of superficial nerves (trigeminal, intercostal, etc.) the use of solutions of cocaine of from 10 to 20 per cent. with the anode is indicated. In all such applications for the relief of pain the electrode should be held steadily at one spot (the anode on the painful part, the cathode at any indifferent point) and the current gradually diminished at the end of from ten to twenty minutes without interruption of any kind. *Trigeminal*, *cervico-occipital*, *cervico-brachial*, *intercostal*, *lumbar*, or *sciatic neuralgia* and *rheumatic pains* (like *lumbago*, *headache*, and *migraine*) are all to be treated upon this principle.

Anæsthesia, on the contrary, is best alleviated by faradization and with the faradaic brush. The anæsthetic area should be tapped with the brush with a current strong enough to be painful upon one's own hand. The skin should be dry and, if necessary, made more so by the use of chalk or powdered starch.

In *organic diseases of the brain* and *spinal cord* and in *insanity* electricity is of doubtful service. Any value it may possess is probably due to psychic suggestion. But even such powerful suggestive agency is not to be despised. In some functional central diseases, such as *neurasthenia*, *railway brain* and *railway spine* (traumatic neuroses), *hypochondriasis*, etc., general or local galvanization and faradization are often of considerable service.

Condensed List of Nervous Disorders and the Modes of Application of Electricity where it is indicated :

Abdominal neuralgia.	Stabile galvanization from the back to the abdomen.
Abducens paralysis.	See *Oculo-motor palsies.*
Amyotrophic lateral sclerosis.	Galvanism to the spine and to the atrophied muscles.
Anæsthesias.	The faradaic brush with the current strong enough to redden the skin.
Aphonia (hysterical).	Faradaism with one pole on each side of the larynx.
Asphyxia.	The faradaic brush to the epigastrium, neck, face, and nostrils, or the interrupted faradaic current to the phrenic nerves.
Ataxic paraplegia.	Galvanism to the spine ; faradaism to exercise rigid muscles.
Basedow's disease.	Stabile galvanization, with the anode over the great nerves in the side of the neck and the cathode between the shoulders.
Bell's palsy.	See *Neuritis.*
Blepharospasm.	Anodal galvanization at the outer corner of the eye (10-per-cent. cocaine cataphoresis sometimes useful).
Brain, organic disease of.	Electricity useless except a mild galvanic current only and without interruptions as a placebo.
Bulbar paralysis.	Faradaism or galvanism as needed to contract the muscles of the tongue, lip, and pharynx.
Catalepsy.	The faradaic brush to the surface of the body ; phrenic faradization.
Cephalalgia.	Stabile galvanization of the head ; the static breeze.
Cervico-brachial neuralgia.	Stabile anodal galvanization over the painful nerves, the cathode on the back or in the hand.
Chorea.	Faradaism useful to exercise the muscles, which are sometimes paretic, but only after the choreic movements have ceased.
Coccygodynia.	Stabile anodal galvanization at the coccyx with the cathode on the abdomen.
Contractures.	Faradization of motor points to exercise the rigid muscles, and especially their opponents.
Deltoid paralysis (circumflex nerve).	Faradaism to exercise the muscle.
Depression, mental.	General faradization.
Diphtheritic paralysis.	Exercise of muscles with the faradaic or galvanic current, as required, at motor points.
Dyspepsia, nervous.	General faradization and faradaic baths.
Enteralgia.	See *Abdominal neuralgia.*
Enuresis nocturna.	Sometimes relieved by vesical faradization with one electrode on the symphysis or one (urethral) introduced into the bladder, the other applied to the sacrum ; moderate current with interruptions.
Erb's paralysis.	Faradization or galvanization, according to the reaction, at motor points, to exercise the affected muscles.
Exophthalmic goître.	See *Basedow's disease.*
Facial paralysis.	See *Neuritis.*
Facial tic.	See *Spasm.*
Gastralgia.	Anodal galvanization of the epigastrium with the cathode on the back.
Genital neuroses and psychoses.	General faradization.
Hallucinations.	Galvanism and faradaism have been known in a few cases to stop hallucinations of sight and hearing, probably by suggestion ; the poles to be applied to the affected organs.
Headache.	See *Cephalalgia.*
Hemicrania.	See *Migraine.*
Hemiplegia.	Faradaism to exercise the muscles and prevent contractures ; the faradaic brush in the presence of hemianæsthesia.
Hypochondriasis.	General faradization.

Hysteria.	Faradaism in paralysis and contractures; the faradaic brush in anæsthesia; general galvanization sometimes useful; the static current for suggestion.
Locomotor ataxia.	Galvanization of the spine employed usually, but of no actual benefit. Anæsthesia to be treated with the faradaic brush; lightning pains with the galvanic anode (occasionally cocaine cataphoresis).
Lumbago.	The faradaic brush for counter-irritation; the galvanic anode to the painful region.
Mastodynia	Anodal galvanization of the painful spot, the cathode on indifferent point.
Melancholic stupor.	General faradization.
Migraine.	Galvanism with one pole, on each mastoid process, stabile, from five to ten minutes.
Multiple spinal sclerosis.	Galvanism is used, but is of no actual service.
Musculo-spiral paralysis.	Faradization of motor points if the extensors react; otherwise galvanism with the cathode to contract the muscles and improve nutrition.
Myelitis.	Galvanism of the spine; faradaism to spastic muscles; the faradaic brush for anæsthesias; the galvanic anode for pain; the cathode or anode for atrophied muscles.
Neuralgia.	The faradaic brush is occasionally useful over the painful region; but the stabile galvanic anode is the best, and, when superficial nerves are affected, cocaine cataphoresis (a 10- to 20-per-cent. solution).
Neurasthenia.	General faradization or galvanization; or the static current for suggestive purposes.
Neuritis (multiple, alcoholic, arsenical, lead, metadip-theritic, rheumatic, etc.).	If the muscles react to faradaism, exercise them with that current; if not, use galvanism; labile galvanization to improve nutrition.
Neuroma.	When superficial, cocaine cataphoresis.
Oculo-motor palsies.	A sponge anode over the eyeball; mild stabile galvanization.
Phrenic-nerve stimulation.	Both sponge electrodes to the two phrenic-nerve points, or one over the nerve and one at the epigastrium, faradaic current, interruption every two or three seconds.
Pianist's cramp.	See *Professional neuroses.*
Pleurodynia.	Stabile galvanization with the anode to the painful point, or the faradaic brush to counter-irritate.
Poliomyelitis.	Labile galvanization to improve the nutrition of atrophied muscles and to exercise them.
Professional neuroses (writer's, pianist's, compositor's, etc.).	Faradaism to exercise the muscles; galvanism to improve the nutrition.
Progressive muscular atrophy.	Galvanism to improve the nutrition and exercise the atrophied muscles.
Pseudo-hypertrophic paralysis.	Local galvanization and faradization of muscles.
Ptosis.	See *Oculo-motor palsies.*
Sacral neuralgia.	See *Neuralgia.*
Sciatica.	A large, flat sponge anode over the painful points, with the cathode as far away as possible; stabile galvanization; a steady, strong current, without interruption, for fifteen minutes daily in recent cases. In old cases electricity is of little value.
Singultus.	Faradization of the phrenic nerve. See also *Asphyxia.*
Spasm.	Electrical treatment of the cause (neuritis, neurasthenia, hysteria, peripheral irritations, etc.); the galvanic anode to the nerve involved and over painful points. Cocaine cataphoresis is useful in superficial nerve spasms (blepharospasm, facial tic, etc.).
Spinal-cord diseases.	Spinal galvanization; a steady current as strong as can be borne (from 10 to 15 milliampères) without interruption; either pole at the nape of the neck and the other on the lumbar region. The distinction between ascending and descending currents in the treatment of chronic diseases of the spinal cord is altogether absurd. The only value of electrical treatment in such cases is probably psychic.
Spinal irritation.	The faradaic brush along the spine; general faradization.
Syncope.	See *Asphyxia.*
Syringomyelia.	The faradaic brush to anæsthetic areas; galvanism to exercise and improve nutrition in atrophied muscles. See also *Spinal-cord diseases.*
Tabes.	See *Locomotor ataxia* and *Spinal-cord diseases.*
Telegrapher's cramp.	See *Professional neuroses.*
Third-nerve paralysis.	See *Oculo-motor paralysis.*
Tic douloureux.	See *Neuralgia.*
Torticollis.	Labile anodal galvanization of the affected muscle.
Trigeminal neuralgia.	The anode over the painful point (with a 10- to 20-per-cent. solution of cocaine); the cathode between the shoulders or in the hand; no interruption; 15 minutes, 15 milliampères. See also *Neuralgia.*
Vesical paralysis.	See *Enuresis nocturna.*
Vomiting (hysterical and nervous).	Stabile anodal galvanization of the epigastrium, with the cathode on the back.
Wrist-drop.	See *Neuritis* and *Musculo-spiral paralysis.*
Writer's cramp.	See *Professional neuroses.*
Wryneck.	See *Torticollis.*

Gynæcology.—I have thought it advisable to add to the foregoing certain of the points of application of electrotherapy in other branches of medicine. Remembering the characteristics of the galvanic current and the different effects of the two poles, we find that there are many gynæcological disorders in which electricity is of great value. The electrodes necessary for such work differ from those required for neurological purposes, and, whereas the neurologist employs a current strength of from 3 to 15 milliampères, seldom as high as 25, the gynæcologist sometimes makes use of from 50 to 200 or more.

One electrode is very large, and the best is the clay pad of Apostoli as modified by Goelet, 6 x 8 inches. This is the external electrode and is generally applied to the abdomen. The resistance of the skin is diminished and current density is lessened by so large an electrode. The internal electrodes are adapted for vaginal and intra-uterine surface application; then, in addition, there is a puncture electrolytic needle to reach tumours, also an aspirating trocar and cannula to reach cysts, etc., from the vaginal and uterine cavities. The positive internal poles must be non-corrodible by acids; Goelet's are the best. The negative may be of any metal. With these general facts in mind, the special therapeutic applications may be condensed as follows:

Endometritis and metritis.	The anode to the diseased parts.
Extra-uterine pregnancy.	The galvanic current is safer than the faradaic. The negative pole, a metallic ball covered with wet absorbent cotton, should be held in the vagina against the extra-uterine mass, and the positive pole, a clay electrode, placed on the abdomen. Gradually increase the current to 50 milliampères and continue it for from eight to ten minutes. Repeat this every second day for three or four *séances*. Interruptions may be tried in some cases, but the current should be then only 25 milliampères. Break six or eight times.
Hæmatoma, Hæmatocele.	The cathode, when the condition is chronic and all sensitiveness has subsided, to hasten absorption (50 to 100 milliampères).
Hæmorrhage.	The anode is hæmostatic and may be used in the first stages.
Hydrosalpinx. (See *Pyosalpinx.*)	Cathodal puncture with a trocar and cannula; only in certain cases, however; all are not adapted to such treatment; from 50 to 100 milliampères.
Menorrhagia. Metrorrhagia.	Intra-uterine use of the anode (50 to 100 milliampères).
Salpingitis, Oophoritis.	The anode, until all acute inflammation has subsided, applied intravaginam against the diseased parts, with a large clay cathode on the side of the abdomen or on the back; 20 to 30 to 100 milliampères from five to ten minutes daily or every other day; at a later period the negative pole.
Small cysts and fibrocysts of the ovary and broad ligament.	Cathodal galvano-puncture through the vagina.
Ovarian hyperæsthesia and neuralgia.	The anode over the affected ovary, the cathode as remote as possible, the current as strong as can be endured without discomfort.
Pelvic cellulitis (chronic), Pelvic exudation and adhesions.	Use electricity only after all acute inflammation has subsided—the cathode in the vagina, the current at the beginning 50 milliampères, afterward 200 every second or third day. If the parts are very sensitive, use the anode to begin with.
Uterine fibroids.	Cathodal galvano-puncture, with a current of from 200 to 500 milliampères. When the tumours are large the patient must be anæsthetized. When hæmorrhage occurs, anodal galvanization of the endometrium, with a current of from 100 to 150 milliampères, should be practised.
Uterine flexions, obstructions, and hypertrophy.	The cathode in the canal; current, from 10 to 50 milliampères.

Various Other Uses in Surgery and Medicine:

Alopecia.	Often benefited by galvanism; an inch metallic cathode on the bald spot; stabile current.
Articular rheumatism.	The anode to the painful joint. An endurable continuous current is only occasionally beneficial.
Asthma.	Galvanization of the neck occasionally beneficial.
Constipation.	Daily application of the faradaic current to the abdomen, best combined with abdominal massage by means of a roller electrode. This is very useful treatment when the disorder is due to atony of the muscular canal.
Dilatation or atony of the stomach.	Energetic faradization to produce contractions is sometimes useful. One of the poles may be placed over the epigastrium or introduced into the stomach (Stockton's gastric electrode), the other held on the back.
Hydrocele.	Cathodal needle in the sac, anode on the thigh; current, from 15 to 20 milliampères.
Muscular rheumatism.	A large galvanic anode over the painful spot, with as strong a current as can be borne, the cathode as far removed as possible. Sometimes an energetic faradaic brush is useful.
Nævi, warts, moles.	Anodic needle.
Stricture of the urethra.	In Newman's method a cathodal sound is introduced into the urethra, and the anode placed at some indifferent spot, a current of from 5 to 8 milliampères being used. This method is firmly believed in by its originator, but has been by many strongly condemned as a means of treating stricture.

Superfluous hairs. A very fine needle in an interrupting handle is introduced downward into the root of and parallel to the hair. The needle is made the cathode. A current from two or three cells, sometimes more, is turned on, until a bubble of gas appears about the needle to indicate the depth of penetration. The procedure is always painful and may be preceded by cocaine cataphoresis if much is to be done. The anode is placed in the hand.

[The resuscitation of persons apparently killed by an electric shock may sometimes be accomplished. The Berlin correspondent of the *Medical Press and Circular* (*Med. News*, Aug. 17, 1895) quotes from the *Pharmazeutische Centralblatt* the following procedures to be adopted in cases of injury from powerful electric currents: The current should be shut off at once if the means are at hand, and the person called upon understands how to do it. If this can not be done, care should be taken not to touch the injured person's body with the hand. If no India-rubber gloves are at hand, the body should be dragged away from the wires by grasping the clothing, or the coat should be taken off and folded (a dry cloth may be used for the purpose), when the injured person may be grasped through it and dragged away. When it is not possible to remove the injured person from the wires, that part of the body should be raised that is in contact with the earth or the wire from it, using the covered hand. This will break the current, and it will generally be possible then to get the body away. If this can not be done, a dry cloth should be placed between the body and the ground, and then the body disentangled from the wires. If the body is freed from the wires, all the clothing should be removed from the neck and the injured person treated as one drowned. The mouth should be opened and the tongue covered with a cloth and grasped. The latter is pulled forward and gradually allowed to fall back. This movement should be repeated sixteen times a minute. Care should be taken that the root of the tongue is thoroughly moved. The bystanders should not be allowed to give the injured person spirit or wine.]—FREDERICK PETERSON.

ELECTROZONE.—This preparation of chlorine and hypochlorites, made by electrolysing sea-water, has been put on the market as an antiseptic.

ELECTUARIES, *electuaria*, are mixtures of medicinal substances, usually dry powders, with honey, syrup, or treacle. They are of soft-solid consistence, and generally, though not necessarily, prepared extemporaneously, the end sought being the more convenient and more agreeable administration of the medicines. In some respects they resemble conserves, but these in contrast with electuaries are combinations of fresh vegetable substances with refined sugar beaten into a uniform mass, the result being that the decomposition the plant would otherwise undergo is prevented by the sugar, and its activities are thus for a time retained. Deterioration of conserves, nevertheless, is rapid and they are used rather as vehicles than for their medicinal activity. Electuaries and conserves are, however, no longer recognised as such by most of the pharmacopœias, although the Ger. Ph. gives general directions for the preparation of electuaries and still recognises an *electuarium e senna*. Both these classes have been merged into the general class of confections, under which name are grouped all those soft solids composed of medicines and saccharine substances and in which the object of the combination is either preservation or convenience of administration. Among the confections of the pharmacopœias, therefore, are recognisable both electuaries and conserves. Few electuaries are official, however, because, as I have said, they are generally extemporaneous combinations of saccharine substances and medicinal powders, in varying and unrestricted proportions, prepared for the purpose of making the administration of powders easy and, save in a few cases, with no reference to being kept when made. In some few cases, however, official directions are given for their preparation, but this is only because of some peculiarity in mixing or of characteristics which make them suitable for being kept made up. Electuaries are of ancient origin and were formerly most generously employed and lawlessly compounded; at present their use is infrequent, for, though it is true that by it medicines are rendered easy and agreeable to take, there is the serious objection to them that the action of sugar upon the digestion is undesirable, particularly in the case of invalids. (See CONFECTIONS.)—HENRY A. GRIFFIN.

ELEMI.—This Oriental resin, resembling turpentine in its stimulating property, is rarely used in the United States, and is never given internally. The *unguentum elemi* of the Br. Ph. consists of 1 part of elemi and 4 parts of simple ointment. It is used as a stimulating application to *indolent ulcers*.

ELIXIRS, *elixiria*, are medicines which are composed of several substances dissolved in alcohol. The application of the word formerly was to preparations of considerable medicinal activity and especially to compound tinctures, spirits, or wines, some of which even at the present time retain the word elixir among their synonyms. Latterly and particularly in America the term elixir has come to mean "a fluid composition containing a little of some drug-principle and a good deal of alcohol, sugar, and aromatic flavouring." In comparison with the old-time elixirs these modern ones are medicinally inactive save for the alcohol they contain, for the amount of medicinal substances in them is insignificant and every remedial value is sacrificed to make them pleasant to the palate. It is the pleasant taste of the modern elixir, together with its poverty in remedial contents and its wealth in alcohol (many of them are one fourth alcohol or more), that makes it the dangerous and traitorous thing it is, for it is taken under the delusion that it is medicinally valuable, and its use, once begun, is likely to be continued because of its pleasant taste and agreeable effects. Elixirs, therefore, provide a very con-

venient means for the cultivation of the alcohol habit. That such an opportunity for "usefulness" should be neglected is too much to expect, and the result is that the proprietary medicine market is flooded with elixirs (whether they bear the name or not) compounded of various ingredients and in varying proportions but all prepared to taste good, to produce a pleasant effect, and consequently to sell. Few elixirs are official, the objections to them being generally recognised, but the U. S. Ph. and the Ger. Ph. authorize a few whose employment is chiefly that of vehicles. The Br. Ph. recognises none. Aromatic elixir, *elixir aromaticum* (U. S. Ph.), contains 12 parts of compound spirit of orange, 375 parts of syrup, 15 parts of precipitated calcium phosphate, and a sufficient quantity each of deodorized alcohol and distilled water to make 1,000 parts. Bitter elixir, *elixir amarum* (Ger. Ph.), contains 2 parts of extract of absinthium and 1 part of elæosaccharum of peppermint dissolved in 5 parts of water, with the subsequent addition of 1 part each of bitter tincture and aromatic tincture. The scarcity of official elixirs need deter no one who desires to employ them, for, aside from the many proprietary preparations to which I have alluded, the Nat. Form. presents no fewer than eighty-six elixirs and gives directions for their preparation.—Henry A. Griffin.

ELM.—See Ulmus.

EMBELIA RIBES.—The fruit of this Oriental myrtaceous plant, dried and powdered, has been found very efficient as a remedy for *tapeworm*. It is given in the dose of from 30 to 60 grains, preceded by a purgative. Its active principle is *embelic acid*, and the ammonium salt of this acid, ammonium embelate, has been found efficacious in doses of from 2 to 3 grains for children and from 5 to 6 grains for adults. Embelia has the great advantage of being pleasant to the taste. Ammonium embelate is tasteless.

EMBROCATIONS.—See Liniments.

EMETICS are remedies which are employed to produce vomiting. The number of drugs that may be productive of vomiting is infinite, and indeed there are few if any which under certain circumstances may not act thus, yet the agents which belong to the class of emetics are few in number. Many a drug has emetic properties which are more or less pronounced, and yet which are entirely subordinate to other and more important actions—actions, indeed, which are often seriously interfered with by the occurrence of vomiting; for that reason these drugs are not employed as emetics, and the occurrence of vomiting during their use is accidental and undesired. In contrast with the numerous medicines of this class are the few which are properly emetics. Their prominent action is to cause vomiting, and their other properties are of less importance. They are agents which are given with the deliberate intention and purpose of causing the stomach to empty itself, and to them only does the name emetic apply.

Emetics act in several ways, and it therefore seems necessary to a perfect understanding of the subject that some attention should be devoted to the physiology and mechanics of vomiting. Though the spectacle is of course familiar to everybody and seemingly a simple occurrence, it is in reality a complex and highly co-ordinated act which even now is in some respects not thoroughly understood. The immediate cause of emesis is compression of the stomach between the diaphragm and the abdominal muscles, but supplemented by the active contraction of the muscular walls of the stomach itself, for the stomach is by no means a purely passive receptacle, to be emptied by external pressure upon its walls alone. The result of these forces (intrinsic as well as extrinsic) is that the contents of the stomach are ejected through the cardiac orifice and the œsophagus with a rapidity and violence which vary with the forces exerted, in some cases the ejection being so forcible as to expel the vomitus from the mouth with considerable violence and for a considerable distance, so that the vomiting is said to be projectile, while in others it is so lacking in force that little more than an oozing forth takes place. A summary of the mechanics of vomiting is thus presented by Marshall Hall: "During the act of vomiting, 1, the larynx is closed; 2, the cardia is opened; and, 3, all the muscles of expiration are called into action; but, 4, actual expiration being prevented by the closure of the larynx, the force of the effort is expended upon the stomach, the cardia being open, and vomiting is effected." To these should be added, however, the active contraction of the stomach itself, to which I have alluded.

To produce and regulate and co-ordinate these various actions, as well as others which are associated with the act of emesis and which I shall discuss presently, elaborate nerve action is required, and of this nerve action the facts are as follows: The regulation and control of vomiting reside in the vomiting centre in the medulla oblongata, and from this centre pass efferent nerves to the diaphragm, the abdominal muscles, and the walls of the stomach, as well as to other parts whose actions are associated with the act of vomiting, while to this centre there lead afferent nerves from various parts of the body, notably the fauces, the stomach, and the abdominal organs. The activity of this vomiting centre results in the production of emesis, and this activity may be started in several ways: First, by direct irritation of the centre itself, either by substances which reach it by way of the blood, as is said to be the case in Bright's disease, or by the occurrence of cerebral disease in its vicinity, as may be the case in meningitis and tumour of the brain; second, by impressions which pass to it from the higher cerebral centres, of which depressing emotions offer an example; third, by a vast number of peripheral impressions which pass to the centre through any of its afferent nerves, in which case the vomiting is said to be reflex, an example being found in the reflex vomiting of pregnancy.

As vomiting accompanies morbid conditions and is produced in one of the three ways de-

scribed, so therapeutic vomiting is induced, save only by the second method, or that in which the vomiting is the result of mental conditions, which can not be employed. Emetic remedies, therefore, act either by direct irritation of the vomiting centre or else reflexly, and this has led to their division into the two classes of *centric emetics* and *peripheral emetics*. Although it is established that emetics may act in either of these two ways, it is not established that there is not another manner of action, and indeed there seems good reason to believe that the stomach may act independently of the nerve centres, for experiments on animals would seem to prove that emetics given internally may produce vomiting even after the pneumogastrics have been cut. Furthermore, it is thought that emetic drugs which are excreted by the stomach when otherwise introduced may act purely by their local effect upon the gastric mucosa. The subject is therefore scarcely so simple as it at first seems, and the division of emetic remedies into the two classes centric and peripheral becomes liable to misconception. The classification by name is, however, relatively unimportant provided the manner of action is understood. Although in disease there are many and widely separated conditions which may reflexly cause vomiting, therapeutics finds but two reflexes which are useful for the purpose—the faucial and the gastric—and, as the former is trivial and not medicinal, it may, for the purpose of classification, be disregarded. Reflex vomiting, therefore, is medicinally elicited only by the introduction of emetic drugs into the stomach. For the reasons already given, however, we can not feel sure that all the emetics thus administered are really effective by reflex action alone, for a part of their effectiveness may be due to independent gastric action.

As these things are so, the only classification of emetics which is at present possible, unsatisfactory though it is, is into *direct emetics*, or those which when given internally cause vomiting by their action on the stomach, whatever may be the character of this action; and *indirect emetics*, or those which, however introduced, cause vomiting by their action upon the vomiting centre when carried to it by the blood. Because of this activity only after conveyance by the blood, indirect emetics are sometimes known also as *systemic emetics*. Apomorphine is the only drug which is purely and simply an indirect emetic, for, though ipecac and antimony also have this action, they produce vomiting by a direct action upon the stomach as well. These two drugs, therefore, are both direct and indirect emetics. The direct emetics are more numerous and include tepid water (neither cold nor hot water is emetic), sodium chloride, mustard, chamomile, alum, ammonium carbonate, zinc sulphate, copper sulphate, and turpeth mineral. So far as the actions of emetics are concerned, there are among them differences which are of the greatest practical importance. Thus, promptness of action is more certainly obtained by the use of direct emetics, or those which act by irritation of the stomach, than it is by employing those which produce emesis only after they have been absorbed by the blood. In cases of *narcotic poisoning* the use of the direct emetics is far more certain and reliable than that of those which act only upon the vomiting centre, because in such cases the irritability of the vomiting centre is lessened in common with that of other centres. Direct emetics, too, are generally far less depressing than those whose action is central, for indirect emetics, in acting upon the vomiting centre, seem also to depress the vital centres which are situated near it in the medulla. So far as the administration of emetic drugs is concerned, those of direct action are given invariably by the mouth, while those of central action are effective however their admission to the circulation is accomplished. Thus, they may be administered by the mouth, by the rectum, or subcutaneously. That ipecac and antimony are indirect emetics has already been said, but, since they are direct emetics as well, their action is also evoked by internal administration, and in practice they are not otherwise given for this purpose. Apomorphine, then, being the only drug whose action as an emetic is purely central or indirect, may be given by any of the channels I have mentioned, but practically its use as an emetic is confined to its hypodermic injection.

Although emetics are defined as remedies which are employed to produce vomiting, their use is not confined to that, for there are several phenomena which precede, accompany, or follow emesis that are often of much therapeutic value and are intentionally elicited by the use of emetics, the occurrence of emptying of the stomach being a secondary consideration. The production of vomiting, therefore, is the chief, though not the exclusive, therapeutic purpose of emetics. In order that these other uses of emetics may be understood, it will be necessary for my purpose to consider the phenomena which occur in association with the act of vomiting. When an emetic is administered there follows a time of variable length which is unmarked by symptoms, but soon the approach of vomiting is indicated by a sense of uneasiness, discomfort, nausea, faintness, and relaxation. With these there are pallor, coolness and dampness of the skin, weakness and perhaps irregularities of the pulse, sighing, and salivation. Occasionally sneezing or coughing may precede the act of vomiting, while the production of bronchial mucus is generally increased. With the ejection of the contents of the stomach the appearances change, the skin, and especially that of the face, becoming flushed and even engorged, while the pulse is rapid and full. The vomiting which now takes place is, as we have seen, an expiratory phenomenon, and the result is that during the act there is such compression of the chest as tends to expel the contents of the respiratory passages as well. This action is, however, more pronounced as the expulsion of the stomach contents ceases, for then a forcible and violent expiration takes place which serves not only to prevent the entrance of vomitus to the larynx, but also to clear the

respiratory passages of mucus. Thus, by the action of emetics, not only is the stomach cleared of its contents, but so are the bronchi also, and the latter the more as an increase of bronchial secretion will have preceded the expulsive act. With the emetic effort, too, the gall bladder is compressed and the bile is forced out into the duodenum, perhaps to appear later in the ejecta if the vomiting is continued. At the same time the abdominal circulation is profoundly affected by the emptying of blood from the portal system.

As the expulsive efforts cease, the condition again becomes one of relaxation and limpness. The pulse is now small and soft, the skin is pale, cool, and perspiring, the breathing is shallow, the muscles are feeble in the extreme, and the mental condition is one of languor. Exceptionally the condition may indeed be one of alarming and even of dangerous syncope. The number and the severity of the phenomena which accompany vomiting vary much according to circumstances—the character of the individual, the presence or absence of disease, and its nature if it is present, but depending particularly upon the agent by which vomiting is produced, the dose in which it is given, and whether or not it causes nausea, for it is upon the occurrenee of nausea that the symptoms of relaxation and asthenia will chiefly depend. A remedy may in fact cause aetive vomiting, but with so little nausea that prostration and relaxation will be slight; on the other hand, a remedy may nauseate and consequently relax without producing emesis. It is thus that ipecac and antimony, as well as other nauseating emetics, act when given in doses insufficient to cause vomiting, an action which has led to their incorporation with other remedies so used into a class called nauseants.

The therapeutical applications of emetics are several. Primarily they are used for the purpose of emptying the stomach whenever its contents are such that their retention would be injurious to the individual. Poisons are thus removed, also food which is harmful either in quality or in quantity. Children in particular are apt to suffer from the *indigestion* which results from overeating or from eating unwholesome food, and in such cases the administration of an emetic is strongly indicated. The emetic which will be proper for this purpose will usually be one whose action is direct and unaeeompanied by much nausea and consequent depression, warm water, salt and water, or mustard and water being especially applicable and to be supplemented perhaps by digital irritation of the fauces. In like manner are to be treated reflex disturbances whose causes lie in improper gastric contents and which are exemplified by *infantile convulsions* and *urticaria*. In adults *headache* may have this causation and call for a similar remedy. As regards the presence of poisons in the stomach, many of them, if irritating, will themselves cause vomiting, but, even so, their perfect and complete removal is seldom spontaneously accomplished, and emetics are therefore required. Under these circumstances there is no treatment so valuable (save lavage) as the free administration of warm water. This will generally be promptly rejected, but, if it is not, faucial irritation will assist in its rejection, and the process of drinking and rejecting may be repeated several times with the result both of diluting the poison and at the same time of removing it as effectively and as completely as is done by means of the stomach-tube. In case the poison which has been taken is of the *narcotic* variety, this emetic employment of warm water may not be applicable on account of the patient's inability to perform the act of swallowing repeatedly. Under these circumstances a full dose of zinc sulphate, alum, copper sulphate, or turpeth mineral may be admissible, and will generally be effective. If the patient's condition is such that no swallowing is possible, the hypodermic administration of apomorphine may be practised, but, as has already been said, an indirect emetic is less apt to be effective in narcotic poisoning than a direct one, because of the lessened irritability of all the nerve-centres which results from the narcotic which has been taken. Moreover, the depression which invariably results from the action of an indirect emetic may be undesirable or not allowable. In cases of narcotic poisoning, then, if swallowing is not possible, and if therefore irritant emetics can not be given, the use of the stomach-tube is invariably to be preferred to the subeutaneous injection of apomorphine, and even if swallowing is possible lavage is probably more radical and thorough a procedure than the giving of irritant emetics, and therefore to be preferred. Emetics are further useful for the purpose of emptying the stomach of such irritating secretions as bile which may be the cause of *continued vomiting*—that is, they may be useful as antemetics. For this purpose it is best to administer warm water, which, being almost immediately rejected, brings with it the bile or irritating secretion on whose presence in the stomach the continued vomiting depends. Thus employed, the warm water acts to wash and cleanse the stomach, the procedure being practically a lavage and beneficial in the same way.

Because of the respiratory phenomena which are associated with vomiting, emetics become useful in a variety of morbid conditions of the air-passages. Thus, the expulsion of *foreign bodies* which have found entrance to the larynx may be effected, as well as the dislodgment of *false membranes*, but unless the membrane is already detached, at least to some degree, there is no reason to believe that an emetic will suffice to cause its removal. The usefulness of emetics in *membranous croup* will therefore depend upon the presence or absence of a previous detaehment of the false membrane. Accumulated secretion in the respiratory passages may also be removed by emetic drugs, and in the *bronchitis of children*, in particular, this mucous retention may be so great as to threaten suffocation. It is in this condition that an emetic may be of such great value in forcibly expelling the bronchial secretion, a service it renders by means of the violent expiratory

efforts which accompany vomiting. The large quantities of mucus often thus expelled are, however, probably not immediately derived from the lungs only, but come in part from the stomach, having previously been coughed up and then swallowed, as is the habit with children. The emetics most serviceable in clearing the respiratory passages are those whose action is violent and not accompanied by much nausea and depression. The direct, or irritant, emetics are therefore to be preferred. In membranous and catarrhal croup, as well as in bronchitis, this avoidance of depression is a matter of much moment, for the asthenia produced by the disease may already be so pronounced that a further increase by the remedy would be dangerous. Care and judgment therefore are necessary in the choice of the emetic, and the more so because the patients are generally children. Ipecac is often given in such conditions, and is undoubtedly beneficial in suitable cases, for it is expectorant as well as emetic. Provided the strength is well maintained, there is probably no remedy so useful, but it certainly is depressing in its action, and, if the asthenia of the patient is pronounced, may on that account not be allowable. Some have thought ammonium carbonate valuable in these cases because of its action to stimulate the circulation and respiration. It seems exceedingly doubtful, however, if a sufficiency of it would be absorbed to exert these actions, and, though the drug may be beneficial for the purpose, it is probably not more so than other direct and irritant emetics, such as sulphate of zinc. In cases such as these antimony is in general to be avoided, because of the depression it induces, and indeed there are cases so adynamic that all emetic agents seem contra-indicated. In *spasmodic croup* (*laryngismus stridulus*), on the other hand, relaxation is directly indicated and expulsion is not. It is for this reason that ipecac is so useful a drug, and, though the nausea it produces is more beneficial than the vomiting, it is generally given in doses sufficient to effect both results. Although laryngismus stridulus is certainly rare in adult life, there occur in later years *spasmodic affections of the respiratory apparatus* whose removal is accomplished in the same way as that of spasmodic croup is. *Asthma*, in particular, may be so benefited, and when this treatment is employed for adults it is customary to give remedies and doses which will nauseate rather than those which are emetic. For this purpose lobelia may be administered or any of the nauseating emetics. The benefits which result from the use of small doses of antimony and ipecac as depressing expectorants are explicable in the same way, for bronchial relaxation is an early part of their action as nauseants and emetics. Their value in the early stages of *acute bronchitis* has thus been explained, and particularly in those not infrequent cases where the element of *bronchial spasm* is present.

As bronchial relaxation is evoked by the use of nauseants, so *spasm* elsewhere may be combated and relieved, and in times gone by various *spastic conditions* were corrected by the administration of nauseant emetics. The reduction of *dislocations*, in particular, was accomplished in this way, as was the relaxation of a *rigid os uteri*, but since the introduction of the general anæsthetics this use of emetic remedies has been given up because of the greater relaxing effect of anæsthetics, and because their results are less disagreeable.

Emetics have been used, and are still used to some slight extent, for the relief of certain morbid abdominal states and especially those of the liver. In *biliousness* they are sometimes employed and in *catarrhal jaundice*, their service in the latter condition being thought to depend upon the biliary expulsion they produce, by which the mucus which obstructs the bile ducts in this condition is removed and the flow of bile re-established. In *biliary lithiasis*, too, they have been employed, and for a similar purpose—the expulsion of the morbid contents of the ducts. The weight of opinion, however, seems strongly against this treatment, for it is believed that, though expulsion of the calculus may indeed occur, rupture of the gall bladder or bile ducts is little less likely.

Emetics of the nauseating variety have been used to diminish *vascular excitement* and benefit *congestive conditions*. This they accomplish by means of the relaxation and depression they cause in the organs of circulation in common with the other parts of the body. Their action in such cases is comparable to that of the vascular depressants, aconite and veratrum viride, but their use is certainly far more disagreeable because of the nausea they produce, a nausea which is the more difficult to bear because, for the full effect of the treatment, it must be continuously kept up. *Acute bronchitis*, in particular, has thus been treated, but, as Wood points out, vascular sedation alone can not be credited with the benefit which may follow, because a part of it is undoubtedly the result of an increase of bronchial secretion.

A curious use of emetics is their administration in the early days of *acute febrile disease* with the object of breaking up the disease (whatever that may mean). *Typhoid fever* has thus been thought to be broken up by an emetic dose of antimony given in its early days. It is easy to see how antimony or any other emetic might be beneficial in this or in any other disease, provided the stomach contained morbid and noxious material which would thus be removed, but apart from this action, which would be exerted certainly in no more than a small proportion of such cases, it is difficult to see how any benefit could result, and the remedial action is not rendered more comprehensible by attributing it to a "shock to the system." That the system may be shocked by the use of emetics, and at times dangerously, is undoubtedly true, but that this shock may be therapeutic seems questionable, save perhaps in the case of aggravated and persistent *nervous disturbances*. Incipient *delirium tremens* and the *status epilepticus* may perhaps be broken up by this shock, but that diseases due to specific infections should be thus benefitted is certainly incomprehensible. Nevertheless, it is said that a *malarial*

paroxysm may thus be aborted, and diseases such as *scarlatina*, *typhus fever*, and *typhoid fever* "broken up" in their early days.

These, then, are the uses to which emetics have been and may be put, but by far the larger number of the conditions named are now treated by other means, more wisely and more efficiently. At the present time emetic therapeutics is confined practically to the accomplishment of two results, the emptying of the stomach and the clearing of the respiratory passages, including their relaxation.

The contra-indications to the use of emetic remedies are not numerous, but are vastly important, for, though vomiting seems simple and harmless enough in the large majority of cases, it must not be forgotten that it may lead to a dangerous and even a fatal result. The conditions which forbid the employment of emetics in general are those in which straining and violent muscular effort might be harmful, as well as those so asthenic that further weakening would be dangerous. Among them are aneurysm, atheroma, cerebral congestion and inflammation, gastric inflammation and ulceration, hernia, advanced pregnancy, and circulatory and general weakness if pronounced. To be sure, emetics may seem necessary in some of these conditions, and then it is a matter for the careful consideration of the physician whether their use is admissible at all, and if so what ones are least likely to be harmful and how their ill effects may be prevented and guarded against. Thus, in conditions of exhaustion an emetic which will not nauseate might be allowable where a depressing one would not. Depression, too, might be counteracted by the use of stimulants. In gastric inflammation warm water would be less harmful than the administration of irritants, or apomorphine might be given subcutaneously. Caution, too, rather than inhibition would seem to be demanded by pregnancy and hernia.

In administering emetics they should in general be given generously, that is, if emesis is the end sought and not nausea, for unless the dose is adequate it is apt to be productive of depressing and disagreeable symptoms without the relief which vomiting brings, and, moreover, will require repetition. If given by mouth (and all save apomorphine are so given), they should be administered mixed with warm water, while as an adjuvant to their action, as well as to render vomiting the easier, the warm water may be generously and frequently repeated. Finally, the persuasive effect of introducing the finger within the fauces should not be forgotten.—Henry A. Griffin.

EMETINE.—See under Ipecacuanha.

EMETO-CATHARTICS are remedies which produce both vomiting and purgation. The power to act thus resides in a large number of drugs whose action is irritant, notably in the drastic cathartics, though the manifestation of the power is generally apparent only when the remedies are given in doses unusually large or toxic. That is, the production of emeto-catharsis is generally toxicological rather than therapeutical. Remedial emeto-catharsis is comparable to that which characterizes cholera morbus and similar digestive diseases, and certainly in the larger number of cases is in like manner indicative of gastro-enteric inflammation. The use of drugs for the double purpose of causing vomiting and purgation is a very limited one, and its obstacles and disadvantages are almost self-evident. Thus, if a remedy is given to cause purgation, it must, at least to some degree, be retained in order to produce that result, while if its object is emesis the very fact that vomiting takes place will tend to lessen its operation as a cathartic. The double action may, however, be attained if the remedy is given in a sufficient dose, but, as these remedies are necessarily irritating, this matter of dose becomes one exceedingly difficult to determine, for on the one hand a dose too small will not produce emeto-catharsis, while on the other a dose too large may produce an undesirable degree of gastro-enteritis. For these reasons the use of emeto-cathartics is not practicable, and if it is desired to cause both vomiting and catharsis it is far wiser to administer an emetic and afterward, when this has completed its mission and the stomach has become sufficiently settled, to give a cathartic.

The objections made to emeto-cathartics as single remedies holds true also of emeto-cathartic combinations, for they are not reliable and are generally either inefficient or else unduly active. Nevertheless, there is employed in France a solution to which the term *éméto-cathartique* is applied, which consists of 5 centigrammes (about $\frac{3}{4}$ of a grain) of tartar emetic and 15 grammes (about $\frac{1}{2}$ an oz.) of sodium sulphate in 150 grammes (about 5 oz.) of water. Of this, one third is given every quarter hour.—Henry A. Griffin.

EMMENAGOGUES are agents which have the power to induce or to stimulate the menstrual flow. Some of these agents act directly by determining an increased flow of blood to the pelvic organs, others act indirectly through their effect on the general nutrition. Direct emmenagogues are now seldom employed. *Amenorrhœa* is to be regarded, not as a disease, but as a symptom of some general or local pathological state, and, as a rule, the rational treatment is addressed to the cause which underlies the menstrual disorder.

In debilitated subjects general hygienic and tonic measures are in order. Suitable open-air exercise, proper nutrition, sufficient sleep, and the regulation of the excretory functions are in such conditions important aids in restoring the menstrual function. Bitter tonics and cod-liver oil are often indicated. In *anæmia* or *chlorosis*, iron, manganese, and arsenic are the most effective emmenagogues. Iron is frequently prescribed alone or in combination with chlorate of potassium or with arsenic. The ferruginous preparations are given in small doses directly after meals. To realize the best effects of iron, the state of the bowels should be watched and constipation prevented during its administration. In conjunction with these measures the use of vaginal tam-

pons saturated with boroglyceride and that of hot vaginal douches are of service. No drugs are more frequently employed for the restoration of the menstrual flow than the preparations of manganese. Like all drugs employed for the purpose, they are most effectual when their use begins a few days before the expected date of the catamenia. They are especially useful in *tardy menstruation of young women* and in *suppression from exposure to cold.* The permanganate of potassium has been extensively employed. It is given in doses of 1 grain, in plenty of water, three or four times a day. A more eligible preparation and one more commonly used is the binoxide of manganese. It is better borne by the stomach. The dose is 2 grains every two hours. The lactate, in the same doses as the permanganate, is sometimes employed.

Guaiacum stimulates the menstrual flow in the amenorrhœa of rheumatic subjects. Strychnine, in the usual tonic doses, is thought to be sometimes of service.

Few emmenagogue measures have been more warmly praised than electricity. The galvanic, the faradaic, and the static currents have been employed. When galvanism is used the negative pole is connected with a small intra-uterine electrode, and the positive pole with a large dispensing electrode placed over the nucha. A current of from 10 to 20 milliampères is continued for five minutes two or three times weekly. The faradaic current is applied in like manner or by means of a bipolar electrode. A rigid asepsis must be observed. When it is desirable to avoid internal instrumentation, as in young unmarried girls, the external application may suffice. The positive electrode is placed on the nuchal region, and the negative on the sacral. In this method the strength of current may be twice as great as in intra-uterine applications, and the length of the sitting may be doubled. Static currents, it is alleged, are especially suited to chlorotic cases. The efficacy of electricity, however, in all its forms, has been overestimated.

Oxalic acid, in doses of ½ a grain three times daily, is said to exert a remarkable influence on the menstrual function. This is a caustic, corrosive poison, and, if used at all, must be given in dilute solution.

Indigo is reported to have been used with signal success in re-establishing the menstrual flow. The dose is from 20 grains to 2 drachms three times daily. Ammonium chloride, in doses of from 5 to 8 grains every three hours, is sometimes prescribed.

Salicylate of sodium increases the flow of blood to the pelvic organs and has been used as an emmenagogue. The dose for the purpose is from 2 to 4 grains every two hours.

Santonin has yielded good results in the amenorrhœa of chlorotic girls. It is best given in a single dose of 10 grains daily.

Apiol is a stimulant to the circulation of the uterus and is used in amenorrhœa due to functional activity or to anæmia. The dose is from 5 to 10 minims three times daily, best given in capsules.

The following are well-known formulæ for the treatment of functional or organic amenorrhœa:

Dewees's emmenagogue:

℞ Tinct. ferri chloridi....... f ʒ iij;
Tinct. cantharidis......... f ʒ j;
Tinct. guaiaci ammon..... f ʒ jss.;
Tinct. aloes............... f ℥ ss.;
Syrup..................ad f ℥ vj.
M. S.: A teaspoonful three times a day.

Goodell's emmenagogue:

℞ Ext. aloes................ ʒ j;
Ferri sulphatis exsic....... ʒ ij;
Asafœtidæ................ ℥ ss.
M. Div. in pil. No. C.
S.: One to three pills three times a day.

Even in normal blood states there may be a defective determination of blood to the uterus. Here resort may be had to measures for stimulating the pelvic circulation at the time of the expected flow. Hot hip baths and hot foot baths, leeches to the thighs, and mustard poultices or dry cups to the thighs and lower abdomen are sometimes effective in bringing on the menses. Hot vaginal and rectal injections may exert a similar influence.

[The application of an ice bag to the spine, at the junction of the dorsal and lumbar portions, produce a like effect].

Irritating cathartics, administered at the catamenial period, are commonly employed for the purpose in domestic practice. These agents act in part by directly stimulating the pelvic circulation, in part, no doubt, through the nervous system by their effect as reflex stimulants. Ammonia and other diffusible stimulants at the time for menstruation frequently help to restore the flow.

The intra-uterine stem pessary, by its mechanical irritation, may provoke the menstrual flow, but the propriety of its use is more than doubtful, owing to the danger of setting up local septic infection. The introduction of a sound into the uterus may act to provoke the reappearance of the catamenia, but, unless great care is used, it is open to the same objection.

A vaginal tampon of cotton wool wet with boroglyceride and renewed every two or three days helps to maintain an active pelvic circulation and favours the return of menstruation.

Among the drugs not already mentioned which are credited with emmenagogue properties are ergot, rue, tansy, aletris farinosa, savine, cotton root, *Polygonum hydropiperoides*, cimicifuga, castor-oil plant, hydrastis, pulsatilla, pennyroyal, eupatorium, black hellebore, digitalis, quinine, myrrh, asafœtida, borax, gold, *Achillea millefolium*, ageratum conyzoides, spirits of juniper, oil of turpentine, nitrous ether, aloes and iron pills, balsam of Peru, bastard dittany, sumbul as a nervous stimulant, saffron, senega, caulophyllum, and mustard.

In general, however, as already intimated, the employment of drugs or other measures intended to stimulate the menstrual function directly must be regarded as irrational and usually injurious.—CHARLES JEWETT.

EMOL.—Dr. W. Allan Jamieson read a note before the Section in Dermatology of the British Medical Association, at its annual meeting for 1893 (*Brit. Med. Jour.*, Aug. 26, 1893), in which he said that this was the "discretional name" of a natural product, refined and purified by various intricate processes, but unsophisticated in any way. He had had the opportunity afforded him of seeing the substance *in situ*, and of following all the stages through which it passed till it emerged as a delicate, soft, impalpable powder. The material from which emol is prepared, according to Dr. Jamieson, is found in large quantity near Dunning, in Perthshire, Scotland. It is allied to fuller's earth, but distinct from most varieties of that earth. Emol contains steatite, silica, and alumina, with a mere trace of lime, and it is probably to the steatite that its peculiar properties are due. Its delicate pink tint is owing to the presence of a very minute quantity of oxide of iron. When it is placed on the tongue there is an absence of the sensation of grittiness so perceptible when fuller's earth of the ordinary kind is tested in a similar way. The first effect noticed when a small quantity—say, a teaspoonful—is mixed with a hard water, such as is met with in limestone districts, in a basin, is its immediate softening influence. Used in this manner with warm water, it acts as a natural soap, cleansing the hands and at the same time leaving them soft and smooth. The workmen engaged in its preparation found that their previously horny palms became so much altered by continued contact with it that they were no longer fit for active manual labour, assuming, as one of them remarked to Dr. Jamieson, a softness more like that of a lady's hand; they could not use their hands for any employment which exposed them to friction. This experience led Dr. Jamieson to try it for the purpose of softening and removing those *horny growths* encountered in some states of *keratosis* of the palms and soles, for which purpose he regards emol as less objectionable than salicylic acid. He found that when a paste of emol and water was applied pretty thickly, and evaporation prevented by the use of an impervious material, such as oiled silk or gutta-percha tissue, the epidermic masses became softened and loosened, and could be pulled off in layers, eventually leaving the part so treated soft, smooth, and pink in hue. In this way Dr. Jamieson was able to remove the hard, horny epidermis in several cases of *eczema of the palm* and *sole*. In a case mentioned the application of emol produced the same beneficial consequences so long as its use was continued, but the condition returned on its discontinuance. As an ordinary dusting powder, perfectly innocuous and inoffensive, Dr. Jamieson thinks emol will be found superior to many now in use. It seems, he thinks, to possess some anticnesmatic power also, for it has very decidedly relieved the *itching* complained of now and then during the eruptive period of measles and in cases of *urticaria*, and it has modified the stinging sensations felt in a part after it has been painted with tincture of iodine.

EMOLLIENTS are remedies which soften and soothe the tissues when locally applied. They are generally fatty substances which are devoid of medicinal activity when thus used, and bland. Their action is principally if not entirely mechanical, and seems to depend upon the protection they afford to the areas to which they are applied, as well as upon the softening and relaxation which follow their absorption by the skin when for some reason it has lost its own fat and consequently has become harsh and dry. In such conditions as *drying*, *chapping*, and *cracking of the skin*, then, the action is probably one of substitution. The protection which emollients afford is manifested in conditions of *cutaneous irritation* and *inflammation*, where, as is well known, access of the air causes an aggravation of the symptoms. This protective action is well exemplified in the emollient results which follow the smearing of bland fats or oils upon burns. Though this protective action is certainly not exclusively the property of fats and oils, and may be exercised practically by anything which is interposed between the air and the surface it irritates, yet something more than mere protection is necessary to constitute an emollient, and in the peculiar softening, relaxing, and soothing which result from the use of fats, whether these are due to mere absorption or to some occult and as yet unexplained action, there lies the difference between a true emollient and a protective. By many poultices are included among the emollients, and, though it is true that they soften and soothe and relax, yet these effects upon the skin are certainly less natural and less permanent than those of fatty substances. The inclusion may be necessary for want of a word to describe the action of a poultice, but, as compared with the bland fats and oils, the mere heat and moisture which poultices provide are certainly not, in the true sense, emollient.

Any bland oil or fat may be used as an emollient (it must be remembered, however, that bland oils and fats, when rancid, become irritants), but those most frequently used for the purpose by physicians are almond oil; olive oil, castor oil, lard, mutton suet, goose grease, cacao butter, vaseline, and their modifications and compounds.—Henry A. Griffin.

EMPLASTRA.—See Plasters.

EMULSIONS, the *emulsa* of the pharmacopœias, are fluid preparations in which oleaginous substances are held in suspension, in a finely divided state, by means of solutions of gum, yolk of egg, tincture of quillaia, or almost any viscid substance. As a rule, they disguise the taste of the drug employed, and present it to the alimentary canal in a condition which renders its absorption easy and rapid. On the other hand, they are open to the objections of readily spoiling, when gum or egg is used as the emulsifier, and of being considerably bulkier than the drug alone. The official emulsions and the ones most commonly employed are those of ammoniac, almonds, asafœtida, and chloroform, to the articles on which the reader is referred, as they differ in

effect in no way from the other preparations of those drugs. Essentially the same as emulsions, differing only in that the drugs employed are not oleaginous, are the *mistura guaiaci* and the *mistura scammonii* of the Br. Ph. Glyconin, the *glyceritum vitelli* of the U. S. Ph., is a useful emulsifier of castor oil and cod-liver oil, about one quarter of the bulk of whichever oil is employed being sufficient to form a satisfactory emulsion which, if necessary, may be prepared extemporaneously. The oil is to be added slowly to the glyconin with brisk stirring or agitation in a bottle, and whatever flavouring, in the shape of any of the essential oils, is selected should be combined last. The official mucilage of acacia of the U. S. and Br. Ph.'s may also be employed in the same manner as glyconin, but is less manageable, except by a skilful pharmacist. By the use of the yolk of eggs very satisfactory emulsions of almost any drug may be made with little trouble, and with considerable advantage in the case of cod-liver oil, as it adds an easily digested albuminoid. When this is used to emulsify oily substances, all that is necessary is to combine them slowly, carefully rubbing them with a spoon. Oil of turpentine and chloroform are conveniently given by the aid of this agent. The white of egg has been employed to a certain extent, but is not entirely satisfactory. Small amounts of tincture of quillaia added to whatever gummy substance is employed will render the emulsification much easier, and in most cases the process is satisfactorily conducted by simply shaking the substances together in a bottle. Caution must be observed that the quillaia, which is somewhat expectorant, is not contra-indicated. For the mucilage of acacia, the mucilage either of Irish moss or of dextrin may be substituted, but with no particular advantage except, perhaps, that of cheapness.

Innumerable emulsions of cod-liver oil, either with or without the addition of phosphates, hypophosphites, malt, preparations of wild cherry, iron, etc., are found in all the pharmacies, but they are more or less objectionable on account of the uncertainty as to the quality of oil used and the impossibility of increasing the dose of oil without adding to that of the adjuvant, which is not always desirable. The majority of these preparations purport to contain about 50 per cent. of oil, but many of them, put up by unscrupulous dealers, fall far short of that figure. Emulsions of castor oil are best prepared with mucilage of acacia or of Irish moss, equal parts of the oil and mucilage readily emulsifying on brisk agitation in a bottle. Almost any desired flavour may be employed, but the essential oils or waters prepared from them are the easiest to manipulate.—Russell H. Nevins.

ENDERMIC MEDICATION is the introduction of remedies into the body by means of their application to the denuded derma, the epidermis having previously been raised by blistering and removed. As is well known, the chief barrier to cutaneous absorption is the epidermis, and it was with the object of overcoming this obstacle and of providing themselves with an effective means of systemic medication that the therapeutists of the past devised and practised the method known as endermic. Considerable success was attained by this means, and the medication was practised for many years, but there were connected with it certain disadvantages which were so serious that with the introduction of the less objectionable method of medication by hypodermic injection the endermic method ceased to have any save an occasional employment. At the present time it must be considered rather as a therapeutic resource than as a practice to be recommended. The disadvantages which militated so strongly against the endermic method were the painful nature of the procedure, the likelihood of its causing obstinate ulceration, and the variability in the absorption which resulted, and hence the difficulty which attended the determination of doses. On the other hand, it offered the advantages of another channel when haste demanded the rapid introduction of remedies by several paths, the avoidance of internal or rectal administration when gastric or intestinal disease made those parts unsuitable for employment, and the possibility of combining medicinal action with that obtained from blistering, which was of special value where local disease was to be treated. It will therefore be seen that the method might well be employed for want of a better one, but it will also be seen that subcutaneous injection is certainly, at least in the larger number of cases, its superior.

In practising endermic medication the following are the details of the process: A blister is created at the chosen site by any of the usual methods, but preferably by the application of cantharis; this is opened, and the elevated epidermis removed with scissors. On the denuded area thus produced the remedy is spread, usually in the form of powder, and absorption takes place with greater or lesser rapidity, according to circumstances. Occasionally, instead of removing the epidermis of the blister, it is simply punctured and, the serum having flowed out, the remedy is introduced through the orifice, the object sought by this modification being the subsequent protection of the excoriation by the epidermis. Although the remedy is preferably to be applied in powder, it may, if it is an irritant, be advantageously combined with some bland substance, such as lard. The drugs which may properly be introduced by this method are not numerous; the alkaloids seem the more suitable ones, and particularly morphine, atropine, and strychnine. The dose of a drug thus employed is usually from two to three times that given by the mouth, but in a first application it is wiser to use no more of the remedy than would be safe were the whole amount to be absorbed.—Henry A. Griffin.

ENEMATA, or *clysters*, are liquid preparations designed for rectal injection. Their objects are several, and I shall proceed to their discussion in the order of their usefulness.

Purgative enemata are those which are given for the purpose of causing evacuation of

the bowels, either as independent agents or as accessories to cathartic drugs which have been taken by mouth. They act by virtue of the irritation they produce, for the rectum is an irritable tube and responds to the invasion by forcibly contracting and expelling the injection together with whatever else it contains. Purgative enemata are therefore so prepared, both in quantity and in quality, that the necessary amount of irritation shall result, as otherwise tolerance might occur and the injected matter be retained. To this end the quantity of the liquid injected is large, that distention of the rectum may be produced, and consequently vigorous peristalsis follow. For adults the amount injected is between 1 and 2 pints, and the quantity diminishes in proportion to the years, the amount proper for an infant being from ½ to 1 oz.; for a child between two and five, from 2 to 4 oz.; and for one between ten and fifteen years of age, from 6 to 8 oz. Besides the expulsive action which results from this mechanical distention of the rectum, peristaltic activity is reflexly obtained by the injection of such substances as will irritate the mucous membrane, and this increased peristalsis is not confined to the rectum, but is manifested by the intestines far above that point. Various measures are adopted to evoke this reflex, and among them the temperature of the fluid injected has much to do with the efficacy of the enema. If the material injected is of the rectal temperature, the tendency will be for it to be retained, or at least not actively to be ejected, though whether it is retained or not will depend upon its other characteristics, for injections sufficiently large or sufficiently irritating will be rejected in spite of their being of the same degree of heat as the body. Their temperature, however, is one element in the successful operation of purgative enemata, and the more it departs from the heat of the rectum the greater is the cathartic activity. Cold fluids are therefore obviously more active than hot ones. Of still greater power to reflexly stimulate the vermicular contractions are medicinal substances which chemically are irritants to the rectal mucosa, a power which may be illustrated by the energy with which evacuation takes place when a small amount of glycerin is injected, though with this energy quantity (so far as distention is concerned) and temperature have nothing to do. These three elements, then—quantity, temperature, and irritant properties—contribute to the greater or the lesser activity of purgative enemata, and in practice they are variously employed and combined. For a mild effect demulcent infusions, such as those of slippery elm and linseed, may be injected, as may olive oil, and even the introduction of a sufficient quantity of warm water may be effective, but if the water is cold the effect is greater, though still mild. Cold injections are of particular benefit in cases of *hæmorrhoids*, which are so often present in those habitually constipated, for the beneficial action of cold applications upon piles is well known. In *biliousness*, too, these cold enemata are of great value, while one of the most satisfactory treatments for *simple catarrhal jaundice* is the rectal injection of ice water. To be effective, the ice water to the amount of a quart should be slowly injected into the rectum once or twice a day and retained for ten minutes before it is permitted to escape. The particular value of this procedure is supposed to reside in a reflex stimulation of the peristaltic action of the gall bladder and the bile ducts resulting from its use.

Of all the enemata for cathartic effect, by far the most frequently used is that of simple soapsuds, which is usually prepared by vigorously agitating Castile soap in warm water. This is an exceedingly effective preparation, and its activity may be increased by the addition to it of various agents, generally cathartics, which are more or less irritating. For this purpose there may be added to the quart of soapsuds used for adults an ounce of castor oil, or 2 drachms of glycerin, or 2 drachms of tincture of aloes and myrrh, or an ounce of magnesium sulphate, while, if still greater activity is desired, from ½ to 1 oz. of oil of turpentine may be added. When turpentine or castor oil is added, however, it should be seen to that it is well suspended in the mixture by the use of a sufficient amount of soap or other means, else separation will occur and the result may be disappointing. Aside from its use to impart a greater cathartic activity, oil of turpentine is often added to enemata for a carminative action when much *flatulence* is present, and when flatulence is to be corrected rather than constipation an emulsion containing from ½ to 1 oz. of oil of turpentine may be introduced, or from 2 to 4 oz. of milk of asafœtida. Besides these there are other agents, such as senna tea and cathartic infusions in general, which are at times injected for the purpose of purgation, and the permutations and combinations of the remedies I have already mentioned are innumerable. A common combination is a tablespoonful each of common salt, molasses, and lard or olive oil or soft soap to a pint of water. Glycerin is also used as a cathartic injection, not only for addition to the soapsuds enema, as already described, but for its individual action. One or two drachms may be introduced into the rectum, but it is ordinarily combined with warm water in variable amount, for undiluted its action is unnecessarily violent and irritating. A commoner method of thus employing glycerin, however, is in a suppository.

The administration of a purgative enema is not a highly complicated thing or one which requires great skill, but it does require care and common sense, for otherwise painful and even serious results may follow. The procedure is as follows: An ordinary hand-bulb syringe is generally employed, and for rectal injection one of its smallest tips is to be attached. This having been done, the apparatus is filled with the fluid to be injected by placing the supply tube in the vessel which contains the enema and squeezing the bulb a sufficient number of times to accomplish the desired result. Should this caution be neglected, the first few squeezes upon the bulb when the apparatus is in position will result in

the expulsion of the air the syringe contains into the gut, an occurrence which will materially add to the patient's discomfort. The tip, having been anointed with vaseline or some other lubricating material, is gently inserted within the anus, and a towel or other cloth is wound about and firmly pressed against the junction of the anus and tip, that, so far as possible, a tight joint may be secured. And now the fluid is injected, slowly, steadily, and with as little interruption as possible, until the entire amount is introduced or until the patient complains of pain. In the latter event the operation of the syringe should cease until the discomfort has passed, when it may be resumed and more of the enema introduced. If severe and persistent pain is complained of, however, the injection should at once be terminated and the syringe removed. After the withdrawal of the tip the towel should be firmly pressed against the anus and retained there in spite of a moderate amount of colicky pain until it becomes evident that expulsion must be permitted. It is then removed and the enema escapes, generally bringing with it more or less fæcal matter. Should the enema be ineffectual it may be repeated after an interval sufficiently long for rest. Occasionally it will happen that an enema is not voided but is retained. Under these circumstances no harm is likely to result, but it is wise to repeat the injection, and the second enema, being expelled, brings with it what is left of the first. The ordinary fountain syringe is preferred by some for the administration of purgative enemata. Its use is not so common as that of the hand-bulb syringe, but it certainly has the advantage of a greater gentleness of action. For glycerin enemata, which are small in quantity, no such procedure, of course, is needed, the simple injection by means of a hard-rubber syringe being all that is required.

The therapeutical application of purgative enemata is naturally to produce evacuation of the bowels, and, though revulsion may indeed be accomplished by their use, it is generally revulsion of an inadequate amount, and their chief employment is for the correction of *constipation*, either as adjuvants to cathartic remedies given by mouth or instead of them. In cases of constipation, therefore, where prompt evacuation is demanded, as well as in cases where the internal administration of cathartics is contra-indicated, lies the chief usefulness of purgative enemata. In *accumulation of fæces* in the rectum and lower colon repeated injection may be necessary, and even this may be insufficient unless combined with digital disintegration and removal. *Habitual constipation*, too, may be treated by the use of enemata, though improperly unless the treatment also includes the more radical correction of the condition by diet, exercise, water-drinking, regularity, and those other remedies which the condition of the individual may demand. Their repeated use, moreover, should never be permitted for more than a brief period, and in cases where anything more than the most infrequent repetition is demanded warm injections should be avoided on account of the local atony and relaxation they cause. In such cases cold injections should invariably be employed.

Aside from the conditions I have mentioned as appropriately treated by laxative enemata are those where cathartic drugs are more often employed, for they may often be used as substitutes for cathartic remedies where those are indicated as well as where they are contra-indicated. The use of enemata may therefore frequently be rather one of choice than of necessity, but in the larger number of cases there will be circumstances which will make the use of either the one or the other especially appropriate. It must be remembered, however, that purgative enemata are not merely rectal in action, but their effect upon peristalsis is manifested far above their area of contact. This, as has been said, is due to reflex action, for, though many enemata contain active cathartic ingredients, it is hardly reasonable to suppose that their absorption is sufficient to bear any other than the slightest part in setting up the widespread peristalsis, though the opposite has been maintained.

There can scarcely be said to be any absolute contra-indications to the use of some sort of purgative enema, but great care will often be necessary in their administration, for, aside from the pain they cause when local inflammation is present and, even if it is not, when they are roughly injected, they are quite competent to cause rupture of the intestine if it has previously been weakened by disease; moreover, fainting may result from their too generous and forcible introduction, though both these accidents are more likely to occur in enteroclysis than with simple purgative enemata. Finally, it must not be forgotten that if they are roughly administered, and especially if their use is long continued, they may be the cause of such unfortunate conditions as fissure, ulceration, and ischiorectal abscess.

Purgative enemata are generally prepared extemporaneously, but some few are official, though not in the United States. The enema of aloes, *enema aloes* (Br. Ph.), contains 40 grains of aloes, 15 grains of potassium carbonate, and 10 fl. oz. of mucilage of starch, mixed and rubbed together. Aside from its purgative value it is said to be an efficient remedy against *threadworms*. The enema of asafœtida, *enema asafœtidæ* (Br. Ph.), contains 30 grains of asafœtida rubbed up with 4 fl. oz. of distilled water so as to form an emulsion. Its special value is seen in flatulent cases. The enema of sulphate of magnesium, *enema magnesii sulphatis* (Br. Ph.), contains 1 oz. of magnesium sulphate, 1 fl. oz. of olive oil, and 15 fl. oz. of mucilage of starch. The enema of turpentine, *enema terebinthinæ* (Br. Ph.), contains 1 fl. oz. of oil of turpentine and 15 fl. oz. of mucilage of starch. It is not only purgative, but carminative.

Nutrient enemata, nutritive enemata, or nutritious enemata, are those given for the purpose of introducing food into the body. Their administration is often spoken of as rectal alimentation. Feeding by the rectum can

only be considered as a poor substitute for the ordinary feeding by the mouth, since it can be employed only for brief periods of time, but in cases in which gastric ingestion is interfered with or gastric digestion and absorption are impaired, as well as in cases of disease where absolute rest of the stomach is demanded, the administration of nutrient enemata becomes of great importance, and often indeed is the only means of saving life. Thus, in *stricture of the œsophagus* and in *pharyngeal paralysis* rectal alimentation may be employed until, with the correction of the morbid condition, swallowing again becomes possible; and even if the condition is irremediable, as is the case with *œsophageal cancer*, life may by this means be somewhat prolonged. In *ulcer of the stomach* no treatment is so valuable as the use of rectal feeding, for by it are secured the nourishment of the patient and at the same time that perfect rest of the diseased part which is so essential to rapid and perfect healing. And what is true of gastric ulcer is quite as true of *wounds of the œsophagus* and *stomach*, whether operative or not, and also of intense *irritability of the stomach*, either with or without actual *gastritis*.

So far as the food injected is concerned, it must be predigested in order that a perfect result may follow, for, though the rectum and especially the colon are capable of active absorption, they are not in any sense organs of digestion. Concentration is also required in nutritive enemata, for absorption is not so complete from the rectum as it is from the stomach and small intestine, and the volume of these injections is necessarily limited. It is therefore necessary that the greatest amount of nourishment shall be contained in the smallest volume. A great many foods have been proposed and used for the purpose of rectal alimentation, and variously modified and combined, but, after all, there are none more reliable and valuable than peptonized milk prepared in the ordinary way. If it is thought advisable, eggs may be peptonized with the milk or, instead of milk, a milk gruel may be peptonized and used. Meat extracts and preparations are preferred by some. They may be given mixed with the peptonized milk or artificially digested and injected alone. In fact, there are at present a number of predigested meat preparations in the market, any one of which is suitable for rectal feeding. The often-mentioned meat preparation of Leube is also desirable, though far more troublesome to make. It consists of from 50 to 100 grammes of the pancreas of swine or cattle, freed from fat, finely minced, and mixed with from 150 to 300 grammes of beef prepared in the same way. To this are added from 50 to 150 c.c. of lukewarm water, and the pasty mass which results is at once injected through a rectal tube. If it is not given at once the meat fibre swells and the injection is made more difficult. Fat is sometimes added to the mixture and occasionally starch. Egg albumen may be given as a nutrient enema with or without the yolk, and if sodium chloride is added in the proportion of 15 grains to each egg it is said that a considerable absorption takes place, though ordinarily the rectum does not take up albumen unless it has been previously converted into peptone. In some cases where rectal alimentation is used stimulation may also be necessary, and then it will be proper to add to each injection from ½ to 1 oz. of whisky.

Aside from the use of nutritive enemata as substitutes for the ordinary alimentation, they may also be used in combination with it as adjuvants when for any reason additional nourishment is demanded. This application of rectal alimentation is, however, seldom required or practised, but occasionally there is employed the injection of defibrinated blood, which Dr. A. H. Smith has described. This practice may be briefly described as follows: The blood is defibrinated by whipping with twigs as it flows from the slaughtered animals. It is injected usually twice a day (in severe cases every two or three hours), warmed to the rectal temperature, and in quantity of from 3 to 6 oz. It is apt to cause constipation, the stools are rendered offensive, and the rectum is coated with an ill-smelling material; but these disadvantages may easily be removed by the occasional use of a cleansing injection of warm water.

Nutritive enemata are in every way in contrast with those designed to purge, for here the end sought is retention, while of purgative enemata the object is expulsion. Nutritive enemata are therefore small in volume, and it is seldom proper to administer more than 6 fl. oz., while 4 fl. oz. is generally a more suitable amount. For the same reason they are given warm, the temperature of the fluid being generally that of the rectum or slightly above it. It has been proposed to give to nutrient enemata an acid reaction, for the reason that theoretically there would be a more rapid osmosis from the rectum, whose secretions are alkaline. Practically, however, this acidity would be but a cause of irritation and hence probably of expulsion; a bland fluid is therefore invariably to be used. In administering nutrient enemata the injection is made most gently and slowly, that the rectal irritability may not be aroused, and for the same reason their repetition should be relatively infrequent, once in six hours being quite as often as it is advisable to give them. Previous to their administration it should be seen that the rectum contains no fæces, else absorption will be less complete, and during the employment of rectal feeding the use of an occasional enema of simple warm water will promote local cleanliness and consequent absorption and tend to diminish the irritation which will necessarily occur to some degree. So far as the giving of the injection is concerned, it may be introduced by the ordinary hand-bulb syringe, but there is much advantage in making the injection through a soft rectal tube to whose external end is attached a funnel. Not only is this rectal tube less apt to cause irritation itself than the hard point of the bulb syringe, but it may be introduced farther into the intestine, and there seems reason to believe that if the injection is made into the colon rather than into the rectum itself retention and absorption are more like-

ly to result. Moreover, the entrance of the fluid through the tube is less forcible than through the syringe, and, gently flowing in, it is much less apt to be ejected. In spite of all precautions, however, the period of time during which rectal alimentation can be employed is a limited one, for sooner or later (in one case it may be a few days and in another a few weeks) there results unconquerable intolerance on the part of the intestine, and the enema is voided as soon as it is introduced. This time indeed may be postponed by the addition of a small quantity of laudanum to each injection so soon as the signs of irritability begin to appear, but in spite of this, too, rectal alimentation can not long be persisted in.

Medicinal enemata are those which contain active remedial agents the object of whose introduction is either absorption and the production of their systemic effects or else local action upon morbid conditions of the rectum or of adjacent structures. Of drugs thus given for their systemic effect little need be said save generalities, for the larger number of drugs whose action is constitutional may be so administered, provided only that they are not locally irritating and that they are capable of being absorbed from the rectum. The matter is, however, far from being the simple one that mouth administration is, for no such power to dissolve and to dispose of remedies lies in the rectum as is possessed by the stomach and upper intestine. Solid remedies may of course be dissolved within the rectum and absorbed, as is evident from the successful employment of medicinal suppositories, but the giving of drugs in a variety of forms and of crudeness is not possible in the case of the rectum as it is in that of the upper portion of the alimentary tract. Moreover, the reaction of the rectal secretions is alkaline, and this necessarily limits the absorption of medicines—a limitation which is not observed in medicating by the mouth, for a remedy thus introduced, if it is not soluble and absorbable in the acid medium of the stomach, may still be dissolved and taken up when it has reached the small intestine and has been acted upon by its alkaline contents. For this reason the rectal administration of remedies which are soluble only in acid media is not rational, for precipitation will certainly occur unless the amount of acid is sufficient to overcome the neutralizing and consequently precipitating effect of the rectal secretion, while, if the acidity of the enema is pronounced, irritation results and therefore expulsion is likely. Nevertheless, acid solutions may be used and are, as for instance in the administration of quinine by the rectum: but the procedure is certainly of limited value and applicability.

So long as acids are not required for their solution, alkaloids are particularly suited for rectal administration, because of the smallness of their doses and their ready absorption, but their incorporation in a suppository is an easier means of introducing them, and they are little used in medicinal enemata. In general, however, and regardless of solubilities, absorption by the rectum is far less sure, rapid, and complete than it is by the stomach and small intestine, and its incompleteness therefore makes necessary the administration of larger doses of remedies than would be appropriate for giving by the mouth. How much larger shall be the doses of remedies thus introduced will depend upon the circumstances of the case and particularly upon the drug, for some drugs are far more completely and rapidly absorbed than others. In general, though, the rectal dose is of twice the size of the dose by the mouth. It would be too long a task to attempt here the discussion of the suitability of individual drugs for rectal administration; that is more properly to be discussed where each drug is separately considered. But in general it may be said that suppositories offer a more convenient and useful means of systemic medication by the rectum than enemata do, provided, of course, the remedy to be used is one whose incorporation in a suppository is possible.

The administration of alcoholic stimulants by the rectum is by all means the most important employment of medicinal enemata for systemic effect, for absorption and diffusion are in their case rapid and complete. Their energy and rapidity of action are increased by heat, and in cases where swallowing is impossible the injection of whisky mixed with water of a temperature as high as can comfortably be borne ranks in effectiveness little below stimulation by hypodermic injection.

The method of administration of medicinal enemata for systemic action is similar to that of nutrient enemata. The medicine should be thoroughly dissolved or suspended in water, and if its character is at all irritating the use of starch water as a vehicle will to some extent overcome this. The quantity injected should seldom exceed 2 oz., and it should be about 100° F. in temperature. Its introduction should be slowly and carefully performed, and every effort should be made to have it retained. Previous to its introduction the rectum should be cleansed, if necessary, by a simple injection of warm water. It is rarely possible, however, to continue the use of medicinal enemata long, for the intolerance of the rectum is easily aroused, and this in spite of every precaution. Medication by the rectum is therefore limited in its usefulness, and but a poor substitute for medication by the mouth.

Medicinal enemata are also employed for their local effect, either upon the rectum itself or upon neighbouring structures. These demand no detailed consideration, for they are fully considered elsewhere. The destruction of *thread* or *seat worms* is accomplished by the use of medicinal enemata, though they may be removed by the injection either of warm or of cold water, or by the use of the ordinary soapsuds enema; an injection more commonly used and probably more effective is infusion of quassia. The official enema of aloes, too, is said to be excellent. *Rectal inflammation* and *ulceration* are also treated by medicinal enemata, which are generally anodyne, demulcent, or astringent. Starch water is frequently the vehicle in such cases, and its soothing action is often most beneficial, and opium, usually in the form of laudanum, may be added if an ano-

dyne is required. Of astringent remedies thus employed, silver nitrate is probably the commonest; a solution containing from 10 to 20 grains to the pint is suitable in strength. Bismuth, too, is occasionally employed in suspension. *Amœbic colitis* is most effectively treated by enemata of solution of quinine, 1 part in 1,000, but the injection in such cases is not the ordinary rectal one, but is rather irrigation of the colon, or a high injection, which is more properly an enteroclysis. (See ENTEROCLYSMS.)

Of neighbouring organs, the bladder is the one whose medication is most commonly effected by enemata. It is usually an anodyne action which is sought in this case, and, though an enema which contains opium or perhaps belladonna is highly efficient, these remedies are oftener introduced in suppositories.

As is the case with purgative and nutrient enemata, medicinal enemata are generally prepared extemporaneously, and qualitatively and quantitatively made up according to the desire of the prescriber. One medicinal enema, however, is official, enema of opium, *enema opii* (Br. Ph.), containing ½ fl. drachm of tincture of opium and 2 fl. oz. of mucilage of starch.

Forced enemata.—See ENTEROCLYSMS.

Gaseous enemata are no longer employed to any extent, though occasionally the forcible introduction of air into the rectum and colon is practised with a view to the reduction of intussusception. At one time the rectal injection of hydrogen sulphide diluted with carbonic acid, as proposed by Bergeon, was considerably practised with a view to favourably affecting *tuberculosis*. Little advantage seems to have resulted from the practice, however, and it has now been abandoned.

[In an editorial article the *Therapeutic Gazette* says: "We believe that large rectal injections, or injections of sufficient size to wash out the sigmoid flexure and colon, are not sufficiently resorted to, particularly in those cases of *diarrhœa* in which a catarrhal element is well marked. In these catarrhal cases it will generally be found that mixed with the watery portion of the discharge there is more or less mucus in strings or flakes, which indicates, as a rule, that a certain amount of the trouble, at least, is situated in the colon. While the rule is by no means an absolute one, the presence of large quantities of mucus indicates very strongly that the whole trouble is in the larger bowel. It is evident, therefore, that the use of drugs by the mouth is a very indirect way of influencing the diseased area, since the medicament must pass through the œsophagus, the stomach, the duodenum, and the small intestine before it arrives at the point where its therapeutic efficacy is to be developed. On the other hand, good results are attained if large clysters are given by means of a hydrostatic syringe elevated not more than eighteen inches or two feet above the rectum. Such treatment will frequently control the movements, limiting them to one or two in twenty-four hours, even if the fluid character of the stool remains unchanged. Various substances have been employed dissolved in the water to be injected. Some of them have not only a powerful local action, but, in addition, are capable on absorption of producing widespread influences throughout the body. Among these may be mentioned salicylic acid and its relatives, nitrate of silver, iodoform when given in oil emulsion, and some of the vegetable astringents. The substance which has always given us the best results under these circumstances is the sulphocarbolate of zinc in the proportion of 10 to 30 grains to an injection amounting to from 2 to 3 quarts. In some instances the water should be tepid, in others it should be as hot as the bowel can stand, and in still others it should be quite cold, the temperature of the injection depending largely upon the acuteness of the inflammatory process and the sensations of the patient, for in the same way that an application of cold water is grateful to a sprained ankle of one individual, while another prefers hot water, so does one patient get comfort from cold injections and another from heated ones. If the water be cold, care should be taken that undue chilling of the body does not result in feeble persons, or if hot, on the other hand, that a mild degree of heat fever is not produced. The success of this treatment depends absolutely, in many instances, upon the gentleness and care with which the injection is given, and the water must be allowed to trickle into the bowel rather than to enter it with any force, for the three reasons that (1) if force is used, the bowel immediately resists the injection and perhaps forces it out. (2) It becomes so irritable that further injections are impossible. (3) This condition of rectal irritability reflexly causes irritability of the entire intestinal tract in much the same way that rectal ulcers may cause diarrhœa, and as a consequence the patient is worse than before the method was attempted. In those cases of *chronic diarrhœa* in which the patient is markedly emaciated and unable to digest much food, so that the condition of impaired nutrition is an important factor in preventing recovery, this method of treatment is to be highly recommended, and it is worthy of note that a small rectal injection, amounting to an ounce or two of iodoform and sweet-oil emulsion, in the proportion of 5 grains to the ounce, injected into the bowel after a large watery movement has passed away, will relieve any tendency to tenesmus and, by the absorption of a small amount of iodine, exercise a useful influence over the catarrhal process which underlies the symptom which we are treating."]—HENRY A. GRIFFIN.

ENTEROCLYSMS are large enemata which are injected not merely into the rectum, but also into the colon and even past the ileo-cæcal valve. They are also known as *forced enemata*, or *high enemata*, and their employment or administration is known as *enteroclysis*. Enteroclysms are administered for several objects—the washing and cleansing of the bowel, the application of medicinal solutions to the intestinal mucous membrane, the reduction of *intussusception*, the removal of

fæcal accumulation, the reduction of *febrile temperature* by the use of cold liquids, stimulation and preservation of body heat by the use of hot liquids, and the restoration to the body of fluid which has been lost by severe *hæmorrhage* or *serous discharge*.

Enteroclysms designed for simple washing and cleansing of the intestinal mucosa consist of warm water or of a 0.6-per-cent. solution of sodium chloride (normal salt solution), while enteroclysms which are intended to medicate consist of aqueous solutions of a number of medicinal agents. There can be no doubt that a large part of the benefit which results from enteroclysis in intestinal disease is due simply to the cleanliness which it causes and the consequent freedom of the intestine from morbid secretions and products of disease—a result which would follow the use of warm water as well as that of a most active medicinal fluid. In many conditions, however, the medicinal action is highly important, and therefore, since medicinal solutions are at the same time necessarily cleansing solutions, the use of simple and unmedicated enteroclysms is relatively infrequent. The clinical employment of cleansing and medicinal enteroclysis is practically confined to *cholera*, *choleraic diarrhœa*, and the various forms of *dysentery*.

In simple *catarrhal dysentery* intestinal cleanliness seems all that is necessary for recovery, and therefore if the colon is irrigated with water, either warm or cold, until the fluid returns clear, and if the irrigation is repeated as often as is necessary for the maintenance of the cleanliness, there is no need to do more, at least locally. Nevertheless, many prefer to use solutions of medicinal agents, principally antiseptics, and among them boric acid, tannic acid, carbolic acid, corrosive sublimate, alum, creolin, and lysol. Carbolic acid and corrosive sublimate, however, are too poisonous and should not be used; the latter, too, is readily decomposed. If an antiseptic is desired, boric acid is the best, and the following solution may be taken as an example:

℞	Boric acid.............	½ oz.;
	Tannic acid...........	45 grains;
	Tincture of opium.....	15 drops;
	Water................	1 pint.

To be given after a dose of castor oil for the purpose of washing out the bowel. (*Therap. Gazette*, August 15, 1894.)

In *amœbic dysentery* the condition is different, for here there is a recognised organic cause for the disease, which must be destroyed if serious results are to be prevented. Medicinal irrigations are therefore indicated, and of them none is so effective as a 1-to-1,000 solution of quinine. In *chronic dysentery*, too, local medication is required, and irrigation with a solution of silver nitrate, 1 grain to the ounce, is especially valuable, and may be practised once or twice a day for several days, when benefit will usually result. By some tannin and other astringents are preferred.

Considerable care is necessary in the treatment of dysentery by enteroclysis, for, especially if ulceration is present, intestinal rupture is by no means impossible. To this end the irrigations should be gently made and the insertion of an outflow tube beside the rectal tube through which the inflow takes place is particularly to be recommended. The apparatus used in giving the enteroclysms consists of a rectal tube of rubber which is sufficiently firm for introduction and yet not hard enough to be the cause of mechanical injury to the gut. Its point should be blunt, and just behind the point there should be openings on opposite sides. To the outer end of the rectal tube should be attached a flexible rubber tube of convenient length, and into the other extremity of this tube should be inserted a funnel. If an outflow tube is also employed it should be short, straight, and sufficiently patulous to allow free passage to mucous shreds and such other matters as may be washed from the intestine. In giving the irrigation the patient is placed upon the back with the hips elevated. The rectal tube is gently inserted until its point reaches the lower portion of the sigmoid flexure; the funnel is then raised and the fluid poured into it. The height of the funnel will of course determine the pressure at which the fluid is introduced, and this should be so regulated that the flow shall be gentle. For the first few minutes it should be rather a trickle than a flow, and the amount of pressure may afterward be increased as may be necessary to cause the fluid to reach and irrigate the colon. No arbitrary directions will apply to this regulation of pressure, but its determination will depend upon the circumstances of the case. No great force, however, is requisite in enteroclysis given for dysentery, because it is not necessary that the ileo-cæcal valve should be passed. Moreover, the use of the outflow tube makes dangerous pressure unlikely. Of the temperature of the injected fluid I shall speak presently.

In choleraic conditions the same principles hold good as in the case of dysentery, for, if the case is simply diarrhœal, irrigation with water or salt solution is all that is necessary, while if the disease is truly cholera the enteroclysm should be medicated. The *summer diarrhœas* of infants and young children are particularly appropriate for treatment by enteroclysis, and the results obtained have been most excellent. The method of administration is essentially the same as in dysentery, and the details of the procedure as given principally by Dr. R. E. Miller (*Therap. Gazette*, July, 1893) are as follows: In the case of children the rectal tube should be a flexible rubber catheter about 10 inches in length and ¼ of an inch in diameter. A hard tube should never be employed. To the catheter is attached a soft-rubber tube which leads from a supply bottle holding about a quart; the advantage of this over the funnel lies in the avoidance of the introduction of air. The catheter, having been lubricated, is gently passed to the sigmoid flexure and the irrigation accomplished by raising the supply bottle. A height of 2 feet is usually appropriate, but greater force can, of course, be obtained by raising the bottle and a lesser one either by lowering the vessel or by constricting the tube. Ordinarily

water is the fluid used, but for the algid stage of cholera infantum warm saline solution is injected. The temperature of the injection varies with the case, for if fever is present, fluid of 52° to 55° F. will act not only to cleanse the bowel but also to lower the temperature. In *hyperpyrexia* water even colder than this is said to be used. It would appear, however, that enteroclysms of such low temperature are dangerous, and that a temperature of 65° F. is quite as low as it is wise to use, and. too, quite as effective as is necessary. Of course, the introduction of cold fluids, and even of iced water, within the rectum is proper and allowable, but not their higher injection, as occurs in enteroclysis. Warm irrigation, as has already been said, is useful in *algid conditions*, and 101° to 103° F. would appear to be the proper degree of heat. Should the child be very weak —even if feverish—warm solutions are used. The frequency with which these irrigations are employed will vary with the demands of the case; every three or four hours is usual, but if the temperature is high they may be given more frequently for a time. The beneficial results from this treatment are pronounced, and the symptoms usually abate rapidly. The factors productive of this beneficial action are several: intestinal cleansing, reduction of temperature in fever or restoration of heat in algidity, stimulation by hot injections, and absorption of fluid to replace that lost by the body, especially when saline injections are given.

The use of enteroclysis for the treatment of all choleraic conditions is due to Cantani, but it is more particularly with the treatment of true *Asiatic cholera* that his name is linked. The objects sought by treatment in cholera, according to Cantani (*Berlin. klin. Wochenschrift*, Sept. 17, 1892), are to check the increase of the spirilla in the intestines, to destroy the poison they produce, to cause elimination of the poison absorbed by the blood, and to diminish the inspissation of the blood by restoration of the fluid it has lost. These things he accomplishes by enteroclysis, using for the purpose a solution of tannin because of the inhibitory action which tannin has been found to possess over the spirillum of cholera, and because of its harmlessness, which is in marked contrast with the irritation resulting from carbolic acid and even, he thinks, from boric acid. The solution which Cantani proposed contains from 75 to 300 grains of tannic acid, from 20 to 30 drops of laudanum, from 450 to 750 grains of gum arabic, and 2 quarts of infusion of chamomile. This solution is injected hot, the temperature usually being in the neighbourhood of 104° F., and this is an essential part of the treatment, because of the stimulating and restoring action of heat, which is so valuable, especially in the algid stage. The method of injection is the same as that employed generally in the administration of high enemata, but the pressure at which the fluid is thrown in is sufficient to insure its passage above the ileo-cæcal valve, for the success of the treatment appears to depend upon the fluid's reaching the ileum, since it is in that situation that the disease is most active. To aid in its reaching the ileum, abdominal massage in the appropriate direction is sometimes employed. Many have doubted the permeability of the ileo-cæcal valve to enteroclysms, but there seems no doubt that it may be so passed, at least in most cases, if the procedure is properly executed, for gentleness and slowness have much to do with success. The benefit produced is the greater the longer the enteroclysm is retained. The frequency of administration will depend upon the severity of the case, three or four injections a day being the usual number. In mild cases one day's treatment may be sufficient, but several days are more commonly required. So far as the results of Cantani's method are concerned, they are certainly superior to those which follow any other treatment; indeed, Cantani maintains that patients treated from the earliest period of the disease invariably recover, and if the diagnosis at an early period is in doubt, enteroclysis should nevertheless be employed, for even in cases not truly cholera the treatment will do no harm. The successfulness of Cantani's method of treating cholera, as I have already said, depends upon no single and exclusive action, but in it there are several factors. These, to be more explicit, are the inhibition of the spirilla and the neutralization of their toxines, constriction of the leaking blood-vessels, acidulation of the intestinal contents, stimulation of nerve action and circulation, restoration of the bodily heat, and prevention of blood inspissation and collapse.

As a means of reducing *intussusception* enteroclysms are often exceedingly useful, a result which they accomplish by mechanically forcing apart the invagination. The method of their introduction is similar to that of enteroclysis in general, but special precautions are to be observed in the procedure. The water or salt solution employed should be of the temperature of the rectum or a little higher and should be injected through the soft-rubber tube introduced within the sigmoid flexure and connected with an ordinary fountain syringe. The flow at first should be very gentle, that the expulsive action of the rectum and colon shall not be aroused, and afterward the bag containing the fluid may be raised little by little until the rectum and colon are filled up to the point of obstruction, for intussusception is most common in the neighbourhood of the ileo-cæcal valve. When the flow has ceased, the intestine being full, the bag may be raised still more and thus the pressure increased, but the experiments of Hare and Martin seem to show that the amount of this pressure should not be great, and Hare (*Practical Therapeutics*, 4th ed., p. 384) places the extreme of pressure allowable at 8 pounds, while a pressure of between 2 and 5 pounds is ordinarily sufficient. The extreme of pressure in the cases of young children he places at 2 pounds, and he lays stress upon the necessity of a slow and gentle introduction of the fluid and a gradual increase of the pressure, that contraction of the intestine may not be produced, and therefore that the introduction

of a large amount of fluid may be possible. His proscription of the Davidson syringe is therefore natural. Much difference of opinion exists as to the amount of pressure which is safe in performing enteroclysis, for some have thought that a rupture of the peritoneal coat of the intestine would result from the use of great pressure, while others have denied the possibility of the accident. Again, some have thought that even much inflammation was not contra-indicative of a considerable pressure, maintaining that before intestinal rupture would take place the ileo-cæcal valve or the anus would yield and the fluid therefore escape. In a normal condition of the gut no doubt such would be the case, but if the intestinal wall is weakened by ulceration or if intussusception has been present sufficiently long for sloughing to have begun, there can be no doubt of the great danger of too forcibly administering an enteroclysm. If, therefore, a large amount of fluid is gently introduced and subjected to a moderate pressure, and reduction is not effected after a short space of time, the fluid should be allowed to escape and the procedure repeated subsequently; but if this treatment is unsuccessful, under no circumstances should violence be indulged in. To this conclusion the teaching of Hare and the dictates of common sense point most conclusively.

There are other applications of enteroclysis, but after what has been said they scarcely demand detailed consideration. Anthelminthic remedies may be applied in enteroclysms for the destruction of the threadworm (*Oxyuris vermicularis*) which is so often found, not only in the rectum, but in the colon as well. The use of irrigation of the colon is at times necessary for the relief of obstruction due to *impacted fæces*. An exceedingly valuable application of enteroclysis is the restoration to the body of fluid lost through severe *hæmorrhage*. For this purpose normal salt solution should be injected, and, since prostration is necessarily present in such cases, and even collapse, the fluid introduced should be hot. In conditions of *shock* and *collapse* from other causes an enteroclysm of hot water containing whisky is often of the utmost value, especially where there is inability to swallow. The restoring and warming and stimulating power of heat thus introduced in *algid states* is indeed of the greatest therapeutic importance. As the bodily heat may be restored by the use of hot enteroclysms, so may it be diminished if cold irrigations are employed. Cold enteroclysms, therefore, may be used with advantage in *fever*, as has already been said in speaking of the treatment of infantile diarrhœa by irrigation. Since fluids given in an enteroclysm pass deep within the body, their effect, if too cold, will be dangerously chilling, while if they are too hot heatstroke may follow. The range of safety, therefore, according to the experiments of Hare and Martin, is apparently from 65° to 103° F., the former being the lowest temperature it is wise to employ in an antipyretic enteroclysm, while the latter is the highest temperature (as the liquid enters the body) it is proper to use for heat restoration and stimulation. These limitations are, clinically, not unduly restricting, for an enteroclysm at 65° F. is effectively antipyretic, while one at 103° F. is actively stimulating and heating.

HENRY A. GRIFFIN.

EPHEDRA.—Several species of this gnetaceous genus of plants are used in medicine. The leaves and aments of *Ephedra vulgaris* (or *distachya*), the sea-grape, *folia et amenta uvæ marinæ*, are astringent and have long been used as a domestic remedy for *diarrhœa* and *gout*. The medicinal action of the plant has been made the subject of clinical investigation by Dr. P. Bechtine, a Russian physician, and a summary of his report is given in the *Bulletin général de thérapeutique*, cxx, 1891, p. 426. He used a decoction of ½ oz. of the twigs and 1 oz. of the root in 3 quarts of water, in doses of a tablespoonful every two hours. Of the patients to whom he administered it, four had *acute articular rheumatism* (one having also *acute pericarditis*), two had *chronic articular rheumatism*, six had *chronic muscular rheumatism*, two had *acute muscular rheumatism*, one had *sciatica*, and one had *rheumatic osteomyelitis*. The best results were obtained in the acute cases of articular and muscular rheumatism. As early as on the second day of the treatment the pain was diminished and the pulse and respiration were strengthened, the fever subsided on the fifth or sixth day, and the swelling of the joints disappeared in a week or ten days. The pericarditis that existed in one case subsided also. The amount of the urine was increased in the cases of acute articular rheumatism with articular swellings. In the chronic cases the effects were less pronounced and not so prompt. In four patients with muscular rheumatism the pains disappeared, and in two they were ameliorated. *Constipation*, with which four of the patients with chronic rheumatism were affected, was overcome by the drug. *Ephedra vulgaris* contains an alkaloid, ephedrine, which is a mydriatic, also another alkaloid, pseudo-ephedrine; the two are isomeric. (See EPHEDRINE.)

Ephedra antisyphilitica is a species that grows in Arizona and New Mexico. It is used in decoction and in a fluid extract as a remedy for *gonorrhœa*. The *U. S. Dispensatory* gives the dose of the fluid extract as from 1 to 2 fl. drachms.

Ephedra trifurcata, supposed to be the *canutillo* of southern Texas, is used as a remedy for *gonorrhœa* and *leucorrhœa* and as a styptic.

EPHEDRIN.—This compound, obtained by decomposing a glucoside found in *Ephedra antisyphilitica*, is supposed to be the active principle of that plant. It should not be confounded with the alkaloid ephedrine (*q. v.*).

EPHEDRINE.—This alkaloid, $C_{10}H_{15}NO$, and an insomeric alkaloid, pseudo-ephedrine, are found in *Ephedra vulgaris*. Ephedrine has come into use as a mydriatic, and its cheapness, the brief duration of its effect, and its alleged freedom from poisonous properties are brought forward in its favour, while the slow-

ness of its action is urged against it. The instillation of a drop or two of a 10-per-cent. solution of the hydrochloride causes moderate dilatation of the pupil in from five to twenty hours. Pseudo-ephedrine has been thought by some to be superior to ephedrine as a mydriatic.

Ephedrine-homatropine solution (the "mydrin" of Merck) is a solution of 100 parts of ephedrine hydrochloride and 1 part of homatropine hydrochloride in 1,000 parts of distilled water. This solution, says Dr. George F. Suker (*N. Y. Med. Jour.*, June 8, 1895, p. 714), seems to fulfil the requirements of an ideal mydriatic for diagnostic purposes. It produces a rather rapid dilatation, though not maximal, and its effects pass off within an hour or two.

In all cases in which this ephedrine-homatropine solution has been instilled Dr. Suker has found greater dilatation than from the use of ephedrine alone, and he says the effects pass off as rapidly as those of ephedrine itself. This solution is perfectly clear and colourless. If it is applied to the eyes of the patient, says Dr. Suker, it may possibly produce a slight smarting similar to the homatropine irritation, yet in the majority of cases no such complaint is made. In a hundred cases no irritation or untoward effect of any kind was noticed. The ephedrine-homatropine solution does not influence the accommodation in the least, he adds, for in each case the near point remained normal, as was determined by the reading of very small test type. Though the mydriatic action is quite rapid and powerful, still, according to Dr. Suker, the pupil never entirely fails to react toward light. After a single application of the combined solution to the eye, he says, the pupil begins to dilate on an average within eight minutes and a half (varying from six to thirteen minutes), and the dilatation attains its maximum within from twenty-three to forty minutes. Within an hour after the application the pupil slowly begins to contract, and after the lapse of from four to six hours has again attained its normal size. The greatest dilatation continues for from fifteen to forty-five minutes, the average being twenty-nine minutes. At the maximum dilatation the pupillary diameter measures from 5 to 6 millimetres, which is sufficiently large, Dr. Suker remarks, for diagnostic purposes. The dilatation disappears entirely in from four to six hours. A solution containing half the amount of ephedrine and more of homatropine—*i. e.*, a solution of 5 per cent. of ephedrine and 0·05 per cent. of homatropine—Dr. Suker has found, causes no irritation, as sometimes the stronger solutions do. With this strength the pupil begins to dilate as early as with a 10 per-cent. solution—*i. e.*, eight minutes and a half after the first application—and a full mydriasis is obtained within forty minutes. The return to the normal width begins a trifle sooner, usually after fifty-six minutes, while the entire influence passes off in three hours and a half. The maximum dilatation continues for twenty minutes, and Dr. Suker remarks that this dilatation is as great, as experiments have shown, as that resulting from the use of a 10-per-cent. solution.

EPIDERMIN.—This is the fanciful name of a milky semi-fluid mixture of equal parts of beeswax, glycerin, finely powdered gum arabic, and distilled water. It was introduced as a substitute for collodion, but does not seem to be preferable to that preparation.

EPISPASTICS.—See Blisters.

EPITHEMS.—Remedial preparations intended for external local application are classed as epithems, unless fat or resins are used as semi-solid vehicles for the drugs, when they are termed plasters or ointments. External medicines are used either for their direct effect upon the skin, or for stimulating or sedative effects upon the cutaneous nerves, or for absorption through the skin into the blood-vessels and lymph-vessels which may carry the active principle to all parts of the body. For the latter purpose epithems were much used in states of *gastric disturbance* and *coma* before the hypodermic injection of medicines was perfected. Cutaneous absorption takes place most rapidly where the epidermis is thinnest, especially over the abdomen, in the axillæ, and on the inner side of the thigh. The absorption of many substances is accelerated by friction or by placing them under a blister.

The usual forms of epithems are: *Liniments*, or embrocations, which usually contain either camphor, glycerin, oil, or soap. If they are to be painted on the skin or to be used without friction, their absorption is hastened by an admixture of chloroform. *Lotions*, or washes, to be applied to a part by means of saturated cloths or absorbent lint. If hot, they are called *fomentations*. *Pastes*, such as arsenical cancer paste, Canquoin's paste of chloride of zinc, potassa cum calce (Vienna), and soda cum calce (London). *Poultices*, or cataplasms, of which a demulcent is the basis. *Powders* which have an absorbent, or protective, or antiseptic effect. *Sprays* for external use.

The therapeutic varieties of epithems are: *Absorbents*, such as dusting powders, glycerin, and purified cotton; *antiseptics*, such as bismuth subnitrate, iodoform, phenol, salicylic acid, and sulphur; *demulcents*, such as bread poultices, flaxseed, and mucilages; *local anæsthetics*, such as a spray of ether or ethyl chloride; *local anodynes*, such as aconite, belladonna, and opium; *local stimulants*, such as arnica, bay rum, and the volatile oils; *rubefacients*, such as ammonia, hot water, iodine, and mustard; *vesicants*, such as cantharides, mezereum, and scalding water; *caustics*, such as nitrate of silver, potash, soda, and mineral acids; *pustulants*, such as croton oil and tartar emetic; and *protectives*, including collodion and gutta percha.

ERGOT, *ergota* (U. S. Ph., Br. Ph.), *secale cornutum* (Ger. Ph.), spurred rye, is the sclerotium of *Claviceps purpurea*, a fungous growth produced within the paleæ of rye, replacing the grain. The fungus at first appears as a filamentous mycelium upon the surface of the ovary. For a time the parasite remains a soft, fungous mass superficially marked by numer-

ous irregular furrows. In this state it is termed the sphacelia. Conidial spores are now produced which spring from the tips of the basidia radiating from the surface of the mass of hyphæ. A belt of more compact hyphæ is developed at the base of the sphacelia. This assumes a violet-black colour and as it grows pushes up the sphacelia, which, torn from its attachments, ultimately falls off. The body thus remaining is the sclerotium or ergot.

A similar morbid growth is found in all the *Graminæ* and in some of the *Cyperaceæ*, but not so commonly as in rye. All ergots probably have similar medicinal properties. The ergots of wheat and of wild rice especially have been found to possess in a high degree the medicinal virtues of the ergot of rye. The latter only has come into general use in medicine.

Ergot in its crude state occurs in brittle yet moderately flexible grains of a slightly curved, fusiform shape. The drug receives its name from the resemblance of the grain to a cockspur. It has a somewhat acrid taste and a disagreeable, fishy odour. The odour is especially developed on rubbing up the powdered drug with a solution of potassic or sodic hydroxide.

The composition of ergot has not yet been satisfactorily determined. The active constituents on which its medicinal properties depend are, according to Kobert, ergotinic acid, sphacelinic acid, and cornutin. The virtues of the latter two ingredients, however, are lost by long keeping.

To preserve the drug for any length of time it must be secluded from air and moisture. Under exposure to these agents the medicinal properties are soon impaired and are ultimately lost. Ergot is also subject to the ravages of a minute insect. Pulverized benzoin or camphor is said to afford protection against worms. As ordinarily kept it is unfit for use after two years.

Except in labour, no appreciable effects are produced by very small doses. In therapeutic doses the principal action of ergot is on the unstriped muscular fibres. It causes especially contraction of the blood-vessels and contraction of the uterus. A powerful stimulant of the vaso-motor nerve centres, it produces tonic spasm of the muscular coats of all classes of blood-vessels and a marked increase in the vascular tension. Its action on the uterus is most strikingly exemplified during pregnancy. The uterine contractions are attributed in part to the direct effect of the drug upon the muscle and in part to stimulation of the centres in the lumbar portion of the spinal cord. Under full doses of ergot the respiratory movements are slowed, intestinal peristalsis is stimulated, and the secretion of urine is increased. The bladder muscles share the general effect of the drug on the unstriped muscular fibres of the body. In some animals the susceptibility to ergot is remarkably small. Two drachms to the pound of bodily weight have been administered to a dog without causing death. The toxic effects of the drug on the human subject are produced only by large and long-continued doses. Cases are reported in which an ounce of powdered ergot has caused no serious ill effects in non-gravid women.

Ergotism presents two principal varieties of symptoms—gastro-intestinal and cerebro-spinal. Of the first order are thirst, salivation, anorexia, nausea and vomiting, pain in the stomach and bowels, and occasionally diarrhœa. The nervous symptoms are formication, numbness, agonizing pains in the extremities, especially in the calves of the legs, frontal headache, dimness of vision, vertigo, stupor, paraplegia, and even convulsions. The arterial pressure is diminished, probably in consequence of cardiac depression and paralysis of the vascular coats. Yet the toxic symptoms vary greatly in different cases.

In some instances both the cardiac and the respiratory movements are reduced in frequency. Among the most striking effects of toxic doses of ergot are great pallor and intense coldness of the surface. The latter condition is ascribed to diminished metabolism. Gangrene sometimes results, probably from blood stasis due to the extreme contraction of the capillary blood-vessels. Doubtless the poisonous effects of ergot are chiefly attributable to its action on the nerve-centres.

Ergotinic acid produces ascending paralysis of the spinal cord and brain, with loss of voluntary motion. Owing to the paralysis of the vaso-motor centres the vascular tension is diminished. It has apparently no ecbolic effect.

Sphacelinic acid causes intense vascular spasm, raises the blood-pressure, and produces tonic contractions of the uterus. The heart muscle is not affected. Kobert believes that sphacelinic acid produces gangrenous ergotism by its action on the blood-vessels and vaso-motor centres.

Cornutin, even in minute doses (0·007 of a grain), causes clonic contractions of the uterus, stimulates the vaso-motor apparatus, and raises the blood-pressure. According to Kobert, it gives rise to convulsive ergotism by reason of its specific action on the nerve-centres. Vomiting and diarrhœa are also produced.

The action of ergot begins usually in fifteen minutes after it reaches the stomach, and attains its greatest intensity at the end of thirty minutes. Its effects last for an hour, at the end of which time the dose must be repeated if its continued action is desired.

The principal therapeutic use of ergot is to cause contraction of the uterus. For this purpose it is extensively employed, both in obstetrics and in gynæcological practice.

As an oxytocic its use is not sanctioned by obstetric authorities. In full doses it causes tonic contraction of the uterus, the normal intervals between the pains being nearly or quite obliterated. The contractions become remittent rather than intermittent. Ergot is therefore dangerous to the child. The placental circulation is partially interrupted by persistent uterine spasm and the child is liable to be lost by asphyxia. Should operative measures become necessary they are greatly embarrassed by the spastic rigidity of the uterus, and the danger of uterine rupture is materially increased. The latter accident may occur under violent ergotic contractions alone, without the added risk of manual or instrumental delivery.

Full doses of ergot, therefore, are never to be given with a view to expediting the birth, unless the prompt expulsion of the child is fully assured on the first vigorous contractions of the uterus. Even here its use is seldom if ever justified, since the delivery may be more safely accomplished by other means.

Yet very small doses of ergot, as Wood contends, act merely to intensify the normal uterine contractions. Ten minims of the fluid extract repeated hourly may serve to stimulate the flagging pains of slow labour with no injurious effect. In general, however, when interference is demanded surgical means are to be preferred to the administration of ergot or other active ecbolic drugs. The chief obstetric use of ergot is to promote the uterine contraction at the end of the third stage of labour. It is now the usual rule to give ergot in obstetric practice only after the uterus is empty of child, placenta, and blood-clots. It may be used with advantage in many cases at this time to maintain full and persistent retraction of the uterus. It is indicated when the uterus remains soft and flaccid at the close of labour, as is frequently the case, particularly after the administration of chloroform. One or two doses of ergot are often justified as a prophylactic against *inertia uteri* after labour when the contractions are not fully up to the normal standard. Its beneficial effects at this stage are fourfold: By preventing the reaccumulation of blood-clots in the uterine cavity it diminishes *after-pains.* For the same reason it lessens the risk of sepsis, limiting the amount of putrefactive material in the uterus. It also tends to prevent the formation of deep coagula in the mouths of the uterine vessels, a condition which adds to the danger of puerperal complications. Finally, by diminishing the blood supply to the uterus, it helps to promote involution. The action of ergot, then, is entirely in the line of the most important indications for the management of the post-partum period.

In women who are subject to *flooding* or in whom for other reasons there is cause to expect a relaxed condition of the uterus after labour, ergot may be properly given at an earlier period, even before the complete expulsion of the child.

The drug is not to be relied on to the exclusion of other means for securing uterine retraction, nor is it to be employed as a routine measure. In post-partum hæmorrhage secale is the chief medicinal reliance.

Ergot is frequently required after abortion, even when the curette has been used. The uterus sometimes remains relaxed notwithstanding a thorough curettage when the operation is done under an anæsthetic. It is contra-indicated here as elsewhere before the uterine cavity has been completely evacuated.

The writer's usual post-partum dose by the mouth is ½ a drachm of the fluid extract, repeated hourly till normal contractions are established. Only in exceptional cases is a larger amount required. Of the solid extract, from 5 to 10 grains may be given.

Usually the best method of administration for obstetric and other cases in which prompt action is demanded is by hypodermic injection. A solution for hypodermic use may be made by dissolving 2 drachms of Squibb's aqueous extract in 1 oz. of water, filtering, and sterilizing. If the solution is to be kept, 1 drachm of the water may be replaced by an equal volume of glycerin, and 12 drops of carbolic acid added to the mixture. The solution, however, does not keep well, and it is better made fresh. From 5 to 10 grains of the solid extract is the hypodermic dose. The writer has in an emergency frequently used the fluid extract subcutaneously with no resulting suppuration.

In gynæcological practice, ergot is employed for the control of certain forms of *uterine hæmorrhage.* Its action as a uterine hæmostatic is twofold: It binds the bleeding vessels by contracting the uterus, and it contracts the vessels directly by its action as a vaso-motor stimulant. Since the general adoption of surgical measures in the treatment of fibromata —curettage, ligation of the uterine arteries, ablation of the ovaries, and hysterectomy— ergot has had only a limited application in the treatment of *metrostaxis* with fibroids or other uterine neoplasms.

Secale is employed to some extent to cause shrinkage of *fibroid tumours,* especially when they are of the interstitial or submucous variety, and even to favour their expulsion from the uterus. The beginning dose for the purpose is one grain daily; this is increased as fast as the tolerance of the patient will permit, the uterine pain produced being the principal guide to the dose. Caution should be observed in the administration of the drug, lest it cause too much cardiac depression. The ergot treatment of fibromata, however, has in recent years given way in great measure to surgical methods.

Ergot is frequently prescribed for the control of various other forms of *hæmorrhage.* It is an efficient hæmostatic in many cases of *epistaxis,* for preventing recurrence of the bleeding, and is one of the most reliable remedies in *hæmaturia,* either of renal or of vesical origin. It is sometimes useful in *purpura hæmorrhagica,* in the *hæmorrhage of scurvy,* and in *hæmo-philia.*

In *pulmonary hæmorrhage* the drug is of little or no value. According to most authorities, its use here is contra-indicated, since it produces a rise in the pulmonary blood-pressure. It is equally unsuitable in *cerebral apoplexy,* and for a similar reason.

It may be given with benefit in *varicose veins,* and sometimes in *hæmorrhoids.*

It has been employed with good effect in *spermatorrhœa* and in *deficient tone of the genital organs.* In *impotence* hypodermic injections about the dorsal vein of the penis are useful when the trouble is due to its emptying too soon. In *enlarged prostate* with urinary retention it is an agent of great value. It often acts well in the treatment of *night sweats,* and is a valuable remedy in *enuresis.* It has been recommended in *congestion of the spinal cord,* and has been used with benefit in obstinate cases of *dysentery* and in *galactorrhœa.*

Ergot appears to increase the action of the bromides in *epilepsy.*

Hypodermic injections of ergot are of some

service in *diabetes insipidus.* Secale is useful for lessening the *tinnitus* and *deafness of quinine* and *of salicylic acid.* When given for this purpose, the dose should be one tenth that of the other drug.

[Ergot is said to exert an exhilarating influence under certain circumstances or in certain combinations. For a number of years formulæ for exhilarant draughts containing ergot have occasionally been published. Such a mixture is that of ergot and sodium phosphate. This particular combination has recently been studied by Dr. A. Luton, of Reims (*Union méd. du Nord-Est; Jour. des praticiens,* Aug. 24, 1895), who finds that the mixture is singularly strengthening and stimulant, but that it should be used only to tide the system over a temporary crisis and not employed continuously for any considerable length of time. He has found it particularly useful in *neuroses accompanied by mental depression,* in the *algidity* of the first stage of *fevers* and of *cholera,* in the *feebleness of infancy,* in *senile exhaustion,* in *tardy convalescence,* and in certain critical periods in *tuberculosis.* He calls the mixture *phosphergot,* whether it is given in the form of a mixture, a powder, or a pill, or used hypodermically. About 15 grains of ergot and 20 grains of sodium phosphate are to be given once a day, before breakfast.]

The preparations most employed are the fluid extract, *extractum ergotæ fluidum* (U. S. Ph.), *extractum ergotæ liquidum* (Br. Ph.), *extractum secalis cornuti fluidum* (Ger. Ph.), and the solid extract, *extractum ergotæ* (U. S. Ph.), *extractum secalis cornuti* (Ger. Ph.). Of the former, the dose is from 10 minims to 2 fl. drachms of the latter, from 2 to 30 grains may be given.

[The dose of wine of ergot, *vinum ergotæ* (U. S. Ph.), is from 60 to 180 minims; that of the infusion, *infusum ergotæ* (Br. Ph.), is from 1 to 2 fl. oz.; that of the tincture, *tinctura ergotæ* (Br. Ph.), is from 5 to 30 minims.

Ergotole is a proprietary preparation of ergot said to be nearly three times as strong as the official fluid extract, and to be free from the nauseous smell and taste of ergot, as well as its irritating properties. Dr. W. C. Kloman, of Baltimore (*N. Y. Med. Jour.,* June 6, 1891), says that he has repeatedly given it by mouth without its exciting disgust or being rejected by the stomach, and that he has met with great success in restraining *hyperæmia* by its local application in *erysipelas* and *phlegmonous inflammations.*

Ergot of maize, or corn smut, has been made the subject of experiment by Dr. Viktorin S. Grüzdeff, house physician to Lebedeff's Obstetrical Clinic in St. Petersburg (*Vratch,* 1894, No. 19; *St. Louis Med. and Surg. Jour.,* Aug., 1894). He writes that he has used it in a series of cases of *tedious labour* (*primary uterine atony*). A fluid extract was invariably used, the dose varying from ½ to 1 fl. drachm. The principal conclusions arrived at by the author may be condensed somewhat as follows: 1. Maize ergot is decidedly a valuable uterine stimulant. In one out of the writer's eight cases the remedy was inactive, but in the seven others it proved efficacious after quinine, mechanical uterine stimulants, cold, and baths had utterly failed. 2. It may be resorted to successfully in all stages of labour. 3. Its action becomes manifest fairly quickly (usually in twenty-five or thirty minutes, never later than forty, after a dose). 4. The pains induced by the drug are of a physiological character—that is, "they represent normal clonic contractions interrupted by regular pauses." 5. The parturient tolerates the drug excellently, having no sickness, etc. 6. The remedy does not show any harmful influence on the fœtus (all the eight women were delivered of living healthy infants). 7. It does not interfere in any way with the normal course of puerperal involution of the uterus..] Cf. ERGOTINE.—CHARLES JEWETT.

ERGOTIN and **ERGOTINE** are names which have been applied to quite a number of different extracts of ergot, which differ from each other both in the mode of preparation and in their constituents, but it is safe to say that not one of them constitutes a pure active principle of ergot.

In 1830 Wiggers obtained from ergot a reddish-brown, acrid powder, slightly soluble in cold alcohol, insoluble in water and in ether, which he called ergotin. It is said by some to be a cardiac depressant, by others to be inert on the vascular apparatus, but to cause colic and gastro-enteritis.

In 1864 Wenzell separated from ergot two alkaloids which he named ecboline and ergotine. They were found combined with ergotic acid, a volatile body which yields crystallizable salts. This ergotine is an amorphous, brown alkaline, slightly bitter powder, soluble in water and in alcohol, insoluble in ether and in chloroform. The hydrochloride crystallizes in needles. Some later observers are of the opinion that Wenzell's ecboline and ergotine are identical.

The ergotine of Boujean (see ERGOTINUM), that of the Fr. Cod., and that in use in the United States differ only a little in preparation, and are extracts of ergot made with a view to the hypodermic administration of the drug. For this purpose that used in this country, which is made according to the formula suggested by Squibb in 1873, is probably preferable.—MATTHIAS LANCKTON FOSTER.

ERGOTININE.—This is a crystallizable, colourless alkaloid, isolated from the fixed oil of ergot of rye by Tanret. It was found in connection with a camphoraceous substance, and, though crystalline at first, soon became resinous. Bombelon is of the opinion that the crystalline ergotinine is a product of decomposition obtained by the action of chemicals on ergot, and that the ergotine of Wenzell is identical with the ergotinine of Tanret.

Solutions of ergotinine are fluorescent, at first of a greenish colour which soon turns to red. The addition of sulphuric acid causes it to assume a red, then a violet, and finally a blue hue. The dose is given as from $\frac{1}{60}$ to $\frac{1}{10}$ of a grain, and Dujardin-Beaumetz recommended for hypodermic use $\frac{1}{100}$ of a grain. It has been proved to have no action on the uterus.—MATTHIAS LANCKTON FOSTER.

ERGOTINUM (Br. Ph.).—This is an extract of ergot practically identical with Bonjean's ergotine. Four fl. oz. of liquid extract of ergot are evaporated to a syrupy consistence, 4 fl. oz. of rectified spirit are added, and the mixture is filtered and evaporated to a soft extract. For hypodermic use 5 parts of this extract should be dissolved in 7 parts each of glycerin and water and filtered. The dose, internally, is given as from 3 to 12 grains, equivalent to from 30 to 120 grains of ergot.

MATTHIAS LANCKTON FOSTER.

ERIGERON, fleabane, scabious, was recognised by the U. S. Ph. of 1870 as the herb of *Erigeron heterophyllum* and that of *Erigeron philadelphicum*, plants which grow wild in several portions of the United States. The odour of erigeron is aromatic and its taste bitter. Physiologically, it acts to increase the quantity of urine, and therefore was formerly used to some extent in *dropsy*. It was given generally in the form of infusion (1 oz. to the pint).

Erigeron canadense, Canada fleabane, was also formerly official in the U. S. Ph., but has been dismissed, since its medicinal virtues are more satisfactorily represented by its volatile oil, *oleum erigerontis* (U. S. Ph.). Canada fleabane grows wild in the more northern portions of the United States, and has been naturalized in Europe. The herb is medicinal throughout, but the flowers and leaves are thought to be specially active. Its odour is aromatic and agreeable and its taste bitter. Its activity is dependent, at least in part, upon the presence in it of a volatile oil, but, though it has been given in substance, in infusion, in tincture, and in extract, its employment at the present time is confined to the use of the oil.

Oil of erigeron, oil of fleabane, *oleum erigerontis* (U. S. Ph.), is a volatile oil obtained by the distillation of the fresh, flowering herb of *Erigeron canadense*. It is a limpid liquid which, though light yellow when fresh, becomes darker as well as thicker upon exposure. Its odour is aromatic and agreeable and its taste pungent and not unpleasant. It is freely soluble in alcohol.

Oil of erigeron resembles the other volatile oils in its action, and especially oil of turpentine, though it is less stimulating than that drug. It has some power as a diuretic, but its chief activity is exerted upon mucous surfaces, and especially when they are atonic and relaxed. It is possessed of considerable power as a hæmostatic, too, when the bleeding is rather of the passive and oozing sort, and its powers seem manifested particularly upon the genito-urinary tract.

The most important therapeutical application of oil of erigeron is in passive *uterine hæmorrhage*, and in this form of *metrorrhagia* it is very highly esteemed. In *menorrhagia*, too, it is often serviceable, while other hæmorrhages are at times benefited by its use, among them *intestinal bleeding* in dysentery and typhoid fever, *hæmoptysis* (when no sthenic symptoms are present), and even *epistaxis*. Various catarrhal conditions of the subacute and relaxed variety are thought to be benefited by its use, among them some cases of *diarrhœa* and *dysentery*, while in the later stages of *gonorrhœa* the remedy may be of great value, taking the place of copaiba or cubeb.

The dose of oil of erigeron is from 10 to 30 minims, given as often as every three hours if necessary. It may be administered in emulsion, in capsule, or dropped upon sugar.

HENRY A. GRIFFIN.

ERIODICTYON.—See YERBA SANTA.

ERRHINES.—See STERNUTATORIES.

ERYSIPELATOUS INOCULATION.—See under TOXINES.

ERYTHROPHLŒINE is an alkaloid obtained from *Erythrophlœum judiciale* (or *guineense*). The tree belongs to the family of *Leguminosæ* (*Cæsalpiniaceæ*), and is found on the west coast of Africa, Senegambia, and Sierra Leone. The best preparation is the hydro-chloride which has been supplied to the trade for the past fifteen years by Merck, of Darmstadt.

Two classes of physiological effects have been observed: Local anæsthesia and convulsive movements resembling those produced by picrotoxin. The first, which is the more important, were made known to the profession through the researches of Dr. Lewin, of Berlin.

These experiments were conducted on cats, dogs, and rabbits, with solutions varying in strength from 1 in 20 to 1 in 4. A solution of 0·1 per cent. was found to be sufficiently concentrated, as when a stronger one was employed more or less local irritation was apt to result.

When 3 drops of this solution were instilled into the eye complete anæsthesia of the cornea and conjunctiva ensued. It is noteworthy, however, that this anæsthesia was tardy in its advent, from fifteen to twenty-five minutes more time being required than would have been necessary had a 4-per-cent. solution of cocaine been employed.

On the other hand, the duration of the local action of erythrophlœine is phenomenal, the anæsthesia persisting for from twenty-four to forty-eight hours. A great drawback to its use is found in its collateral ill effects, especially in the form of severe spasms.

These grave constitutional disturbances preclude its employment in large quantities, and hence it is not likely to be used to any great extent as a local anæsthetic for surgical purposes. But it must certainly be conceded that it is capable, even in the small doses demanded by its constitutional potency, of rendering good service in the management of painful conditions due to purely local causes. I myself have used it in this way, injecting it into the painful areas along the course of an *inflamed sciatic nerve*, or deep down between the vertebræ (and even into the spinal canal) in *spinal irritation* and *locomotor ataxia*.

When employed as last mentioned, it may be, and indeed should be, still further diluted, so that one may inject an increased quantity of fluid into the vicinity of the cord, whereby the probability of producing a definite therapeutic effect is much enhanced, as I long since pointed out. Erythrophlœine hydrochloride is still an expensive preparation, being listed

in Merck's catalogue for 1889 at four dollars a gramme.—J. Leonard Corning.

ERYTHROXYLON.—See Coca.

ESERIDINE, $C_{15}H_{23}N_3O_3$, is an alkaloid found, along with eserine and calabarine, in the Calabar bean. It is said to be less poisonous than eserine and to act powerfully as a cathartic. It has not come into medicinal use.

ESERINE, otherwise known as *physostigmine*, is an alkaloid obtained from *Physostigma venenosum*, or Calabar bean, a woody creeper belonging to the family *Leguminosæ*, indigenous to western Africa.

In 1864 an amorphous, tasteless alkaloid was isolated by Jobst and Hesse from the Calabar bean, and was called physostigmine. At a later date Vée and Leven isolated a bitter, crystalline alkaloid which was called eserine. These were found to be alike in physiological effects, and are at the present time regarded as different forms of the same substance.

Uncombined eserine is not employed in medicine, but is represented by the salicylate and the sulphate. The salicylate (*physostigminæ salicylas* [U. S. Ph.], *physostigminum salicylicum* [Ger. Ph.]) occurs in colourless, columnar crystals of bitter taste and neutral reaction, soluble in 150 parts of water and in 12 of alcohol. The sulphate (*physostigminæ sulphas* [U. S. Ph.], *physostigminum sulfuricum* [Ger. Ph.]) occurs as a white micro-crystalline powder of bitter taste, very deliquescent in moist air, and very soluble in water and in alcohol. The sulphate is the more commonly employed, but the salicylate is the less irritating to the conjunctiva, and is therefore in the majority of cases preferable to the sulphate in ophthalmic work, particularly when its use is to be continued for a considerable length of time. The solution of each is, when fresh, of a faint pink colour, which gradually darkens until it is of a brownish-red appearance. Its efficacy may perhaps be slightly impaired when the solution is very old, and it certainly has then a greater tendency to irritate the conjunctiva, but practically an old solution is just as useful for the majority of cases as a fresh one. It is usually prescribed in neutral solutions varying in strength from ½ to 1 grain to the ounce, but to produce an immediate or rapid effect it may be used in as strong a solution as 4 grains to the ounce, and for continued use a solution $\frac{1}{10}$ of a grain or less to the ounce is usually sufficient. Care should be exercised in prescribing these solutions for patients to use at their homes, and when this is necessary the patients should report frequently to the prescriber, as deleterious effects may result from their overuse. Gelatin discs (*lamellæ physostigminæ* [Br. Ph.]) furnish a very convenient form for the employment of this drug, but sometimes they produce much more irritation of the conjunctiva than a solution would.

Physiologically, eserine produces the same effect on the nervous and muscular system as are caused by physostigma, of which it is the active principle. It is a direct stimulant to muscle fibre in all medicinal doses, and acts the most powerfully upon the non-striated variety. It stimulates the heart and the inhibitory cardiac nerves, first lowering then causing a rise in the arterial tension, increases peristalsis of the bowel, causes contraction of the bladder and spleen, and is said to have excited contraction of the gravid uterus. In full doses it excites nausea, vomiting, salivation, and diaphoresis. Meiosis may follow its internal administration, but does not always. It is excreted in the urine, saliva, and bile, and has been found in the gastric secretions after intravenous injection.

When instilled into the conjunctival sac, eserine causes a temporary increase in the tension of the eyeball, followed by a final and permanent decrease greater than the primary augmentation (Stocker), lessens the corneal curvature to some extent, and causes contraction of the pupil with spasm of the accommodation. The contraction of the pupil and the spasm of accommodation commence in about five minutes after the instillation of the drug, and reach the maximum effect in from twenty to forty-five minutes. This effect is heightened by the local application of heat as well as by the internal administration of mercury and the iodides. The spasm of accommodation lasts only a few hours, but the pupil remains contracted longer, sometimes for several days. The blood supply to the eye is diminished by the action of eserine in causing contraction of the arteries of the conjunctiva and iris, while the veins are not affected. In strong solutions eserine produces ciliary congestion, pain in the eye and head, twitching of the orbicularis, and occasionally spasm of the external ocular muscles by its direct effect upon the muscular fibres. When pushed to produce constitutional symptoms, it may cause giddiness and faintness, with a feeble and irregular pulse and low arterial tension on account of the exhaustion of the peripheral cardiac filaments of the vagi. Such systemic intoxication frequently causes dilatation and abolished reaction of the pupil (Leibholz). Complete, though temporary, blindness has been known to follow general eserine poisoning (Arago). It may be said here, in passing, that eserine poisoning happens most commonly as a result of instillation of the drug into the conjunctival sac. In cases of poisoning atropine should be given, as it is the physiological antidote, heat should be applied to the body, and cardiac and respiratory stimulants should be administered.

Eserine is principally used in ophthalmology, and the principle may be broadly stated that it is indicated in any disease of the eye whenever there is increased intra-ocular tension, unless the iris or ciliary body is involved in the inflammation. In *glaucoma simplex* one drop of a solution of ½ or 1 grain to the ounce, instilled from two to five times a day, reduces the intra-ocular tension very decidedly. In some cases the result of prolonged treatment is very gratifying, the tension becoming and remaining normal, with improvement of visual acuity and of the field of vision, together with disappearance of the pain without recourse to the usual operation of iridectomy. In other cases the tension returns and increases until the eyeball

is of its former hardness in from six to twelve hours after the last instillation.

In *ulcerative keratitis* eserine is often a better drug than atropine, because it has the power of cutting off a superabundant arterial supply, checks the migration of the white blood-corpuscles, tends to promote absorption through dilatation of the ciliary veins, and locally tends to limit the sloughing process. Good results have been reported from its use when the ulcer was complicated with *hypopyon* (Parisolli). In *gonorrhœal ophthalmia* and in *ophthalmia neonatorum*, when the iris is not affected, the best treatment for a marginal ulcer is the instillation of a solution of eserine, from $\frac{1}{6}$ to $\frac{1}{2}$ of a grain to the ounce, one drop every three or four hours during the day. Frequently the best result is obtained by the use of eserine in this manner during the day, combined with the instillation of a drop of the usual solution of atropine at night (De Schweinitz). Though this treatment seems contradictory when first considered, because atropine is so much more powerful a mydriatic than eserine is as a meiotic, its good effect may perhaps be explained by the theory that atropine tends to keep the iris quiet and protect it from irritation, while eserine tends to diminish the arterial blood supply and promote the absorption of the chemosis. Prompt improvement is frequently observed after its use in cases where atropine alone has failed.

In *phlyctænular keratitis* eserine is sometimes useful in diminishing the *photophobia*.

In the chronic form of *episcleritis*, with no iritic complication, the instillation of several drops of a weak solution has been recommended.

In *neuralgia of the eyeball* it is sometimes useful, but occasionally it increases the pain and is then contra-indicated.

The use of a weak solution of eserine has been recommended in some cases of *accommodative asthenopia* without refractive errors, or after these errors have been corrected.

It temporarily diminishes *mydriasis* due to paralysis of the third nerve, not by affecting in any manner the seat of trouble, but by stimulating the peripheral nerve-fibres or the muscle-fibres of the iris directly. It is of great use in the *paralytic mydriasis following diphtheria* (Cameron).

Mydriasis due to the use of atropine is also temporarily diminished by eserine, but its effect is of shorter duration than that of the stronger mydriatics, so that when the latter are overcome by its use they frequently reassert themselves. In complete ciliary paralysis by atropine or hyoscine, eserine is said to produce no effect.

Eserine has been much used after the simple extraction of cataract for the purpose of exciting contraction of the circular fibres of the iris and to so prevent prolapse, but it is less used now than formerly, because it has been found by no means certain to prevent this accident, while it has a distinct tendency to favour the occurrence of iritis.

Eserine is not well borne in acute inflammation, or where there is much ciliary congestion, and is positively contra-indicated in iritis. According to some observers, it has a tendency to increase opacities of the crystalline lens, and this should be borne in mind whenever the advisability of its use is being considered with regard to an eye containing an incipient *cataract*.

The internal administration of eserine has been recommended in *chorea*, and brilliant results from its use have been reported, but it sometimes produces very alarming symptoms. Lodderstädt reports an extreme degree of collapse which resulted from the subcutaneous injection of $\frac{1}{120}$ of a grain into a child nine years old. Profuse perspiration was caused, followed by vomiting and collapse, the pulse was scarcely perceptible, fifty-four to the minute, and the pupillary reflex was greatly diminished.

It will sometimes not only suppress the *night sweats of phthisis* for the time, but prevent their recurrence for three or four weeks.

In *strychnine poisoning* eserine may be advantageously employed, combined with the bromides.—Matthias Lanckton Foster.

ESSENCES, *essentiæ*, as the term is ordinarily understood, are alcoholic solutions of volatile oils. The word essence has been much abused and its applications are, unfortunately, so varied that of itself it can convey no very clear meaning as to composition. This will become apparent when the various forms of essences are considered.

The U. S. Ph. employs the word essence only as an English synonym for certain of its spirits. Its essences of bitter almond, lemon, nutmeg, peppermint, and spearmint are therefore merely the spirits of those drugs.

The Br. Ph. authorizes essence of anise, *essentia anisi*, and essence of peppermint, *essentia menthæ piperitæ*, each being an alcoholic solution containing 1 part of the volatile oil of the drug and 4 parts of rectified spirit. They correspond to the spirits of the Br. Ph. in composition, but not in strength, for, while *essentia menthæ piperitæ* (Br. Ph.) is composed of 1 part of oil of peppermint and 4 parts of rectified spirit, *spiritus menthæ piperitæ* (Br. Ph.) is composed of 1 part of oil of peppermint and 49 parts of rectified spirit. According to the Br. Ph., therefore, essences are stronger spirits.

In Germany the application of the word essentia is liberal to the last degree, for *essentia amara* is synonymous with *tinctura amara* (Ger. Ph.), *essentia menthæ piperitæ* with *spiritus menthæ piperitæ* (Ger. Ph.), and *essentia pepsini* with *vinum pepsini* (Ger. Ph.). Essentiæ, under that name, are, however, not official in the Ger. Ph., though *spiritus menthæ piperitæ* (Ger. Ph.), which contains 1 part of oil of peppermint and 9 parts of spirit of wine, is certainly an essence according to the British standard.

An essence, according to the Fr. Cod., is a volatile vegetable oil, and what are ordinarily classed as volatile oils in the United States are known as essences in France. Thus, oil of spearmint, *oleum menthæ viridis* (U. S. Ph., Br. Ph.), has as a French name *essence de menthe verte*.

The confusion which attends the use of the

word essence would be sufficient were it confined to official nomenclature, but it is increased by popular misapplication, for seemingly with no more valid reason than a desire to convey the impression of strength and of extracted and concentrated virtues the name is given to a variety of proprietary remedies, of which "essences" of rennet, of pepsin, of pancreatin, and even of beef are illustrative.

HENRY A. GRIFFIN.

ETHER.—Sulphuric ether, oxide of ethyl $(C_2H_5)_2O$ or $(C_4H_{10}O)$, the *æther* of the pharmacopœias, is a colourless liquid, gaseous at a temperature above 95° F., and rapidly evaporable at all ordinary temperatures. It is obtained by the dehydrating action of sulphuric acid on alcohol.

The vapour of ether is of high specific gravity, more than twice and a half as heavy as air, and thirty-seven times as heavy as hydrogen. It is very inflammable, a characteristic which demands greatest caution in its manipulation at night.

Ether has a strong agreeable odour and a hot, burning taste. Its internal administration causes a sensation of choking, as is the case with its inhalation.

Therapeutically, the most prominent use of ether is as an anæsthetic in surgical procedures. (For the history of the discovery of ether as an anæsthetic, see under ANÆSTHETICS.) From its comparatively greater safety and, perhaps, because its anæsthetic properties were discovered in the United States, it stands to-day as the great general surgical narcotic of America, though of late its introduction into English and Continental surgical clinics has been rapid. Ether is of use also as a cardiac stimulant and as an antispasmodic, and has been recommended as an anthelminthic and in some neuroses. It is a powerful solvent as well, and is largely used, because of this property, in histological and pathological work. On account of its easy and rapid evaporation, it has uses as a local anæsthetic, though it is inferior in this respect to other agents.

As a general systemic *anæsthetic* ether finds its largest use. It is by far the safest of the surgical narcotics, and is as safe, possibly, as any agent can be which produces the severe systemic disturbance necessary to abolish pain and consciousness. As with every other agent used for a like purpose, its influence upon the respiratory and circulatory apparatus, as upon the blood, is temporarily profound, and there are, therefore, physical conditions which render its use injudicious. Most of the cases of sudden death following or coincident upon the administration of ether have been in patients exhausted by prolonged nervous disease, or by grave acute conditions. Ether has been administered repeatedly—it is elected, in fact—in cases of organic cardiac disease, for it is now established almost beyond doubt that sudden collapse from the action of ether is caused by paresis of the respiratory centre and that its influence upon the circulation is but secondary. Well-established renal disease is recognised by surgeons as a contra-indication to the administration of ether, although it is believed that the occasional transient albuminuria seen after an ether narcosis may arise from infection at the site of the wound or from absorption of some poison contained in the dressings, such as iodoform. In the face of combined renal and cardiac disease ether may be administered, but it must be given carefully, the patient must be keenly watched, and asepsis must be carried to its highest perfection.

[Dr. Robert F. Weir, in a paper On the Influence of Ether upon the Kidneys, read before the American Surgical Association at its meeting for 1895 (*N. Y. Med. Jour.*, Nov. 16, 1895), gives the following conclusions of his extensive and careful researches: "That etherization in the vast majority of cases in normal kidneys, and even in abnormal kidneys, brings about no detrimental effects; that when any evidences of abnormity present themselves they are transitory in character and not productive of harm; that elevation of temperature, which I had before thought would aggravate the work of the kidney and bring about, in conjunction with an ether narcosis, abnormal excretions, does not appear to exercise any positive influence on this point."]

Some operators prefer not to use ether in abdominal section, since they consider the subsequent vomiting and retching likely to break up adhesions or even to tear out sutures. Certainly, however, the other important after-effects should not be overlooked. It is not common for the vomiting that follows the narcosis to continue longer than a few hours, and the patient does not exert sufficient strength to damage a wound materially. In some cases, too, a movement of the bowels may be more easily obtained after ether than after chloroform anæsthesia. Lastly, the greater safety to the patient must be taken into account.

An operation about the face, neck, or head may contra-indicate the exhibition of ether, for ether must be given continuously, and in operations such as these indicated it may become necessary to remove the inhaling apparatus from time to time. This allows the patient to recover partially from the anæsthesia, and in his consequent coughing, vomiting, or straining the parts become more deeply congested and the field of operation becomes obscured by the increased bleeding from the capillaries and open vessels. In order to have a thorough anæsthesia, it may be advisable in such cases to use chloroform or a mixture of anæsthetics. It seems almost unnecessary to state that when the galvanic or actual cautery is called into use during an ether narcosis the greatest caution must be observed that the highly inflammable vapour shall not be ignited.

Although age seems to make little difference as to the susceptibility to ether, many surgeons prefer giving chloroform to children, in order to avoid the possibility of a subsequent broncho-pneumonia. Aged people, women, and children yield to ether more readily than adult men, as a general rule. Heavy users of alcohol and tobacco submit

to ether with great difficulty and sometimes require enormous amounts of the anæsthetic to produce unconsciousness. Occasionally patients are met with who can not take ether, no matter how carefully it is given. There are coughing, vomiting, and an apparently intense dyspnœa, which disappear as soon as chloroform or the "A. C. E. mixture" is substituted.

No part of a surgical operation calls for more skill, keener observation, greater judgment, and more coolness than the administration of the anæsthetic. Unfortunately, an ideal anæsthesia is not often seen. In our large hospitals the youngest member of the house staff in point of service is made anæsthetist, and he is rarely possessed of enough knowledge in this branch of medicine to carry his patient safely through a crisis. The anæsthetist should have his attention concentrated upon *his* work, and should under no circumstances be allowed to watch the operation. This is a matter of such supreme importance, involving, as it does, the safety and lives of so many thousands of beings, that it seems remarkable that it has never seriously attracted the attention of medical boards.

In order to secure a good anæsthesia and as safe a one as possible, the patient must have proper preparation. So far as anæsthesia is concerned, this consists in emptying the bowels thoroughly and in keeping the stomach free from food. The night before the operation the patient should receive half an ounce of compound licorice powder; after the bowels have moved well in the morning, a high enema and at least two low enemata should be given. Four hours before the time set for the operation the patient may drink a cup of milk or a milk punch or may eat a soft-boiled egg. Nothing further should be given by the mouth up to the time of the administration of the ether. If it is deemed necessary, the patient may receive a stimulating enema, containing whisky, 1 ounce; peptonized milk, 2 ounces; tincture of digitalis, 10 minims; caffeine sodium benzoate, 10 grains; deodorized tincture of opium, 15 drops.

When the patient is brought to the anæsthetizing table a careful physical examination of the lungs and heart should be made, if that has not been previously done. The anæsthetist should acquaint himself with the character of the patient's pulse, so as to be able to recognise instantly any change during the narcosis. False teeth should be removed, and the clothing about the neck should be loosened so that respiration may not be impeded. The patient should now be instructed that he must take deep, long inspirations, that the choking sensation which he will feel is but temporary and has no significance, and that he must do whatever he is told to do. The surgeon's tact and gentleness may do much for the patient, for there are few individuals who do not shrink from the total abolition of consciousness.

The method of administration must always remain a matter of choice to the surgeon. Ether inhalers, cones, and masks of every description have been invented, and each surgeon has his own preference. Inhalers made on the principle of the Allis, the Clover, and the Ormsby models are in greatest use at the present time. The Allis inhaler is a serviceable instrument, but allows of too free admixture of air. The Clover inhaler has many admirable features, but requires frequent removal from the face for the addition of a new dose of ether. The Ormsby inhaler includes the good features of most of the modern cones, but requires skill in its use, since, without careful watching, asphyxia plays a part in the anæsthetization; and, in ether narcosis, ether alone should cause the anæsthesia, asphyxia *never*.

A very serviceable ether cone may be made, in an emergency, from a towel surrounded by a newspaper. This combination is folded over on itself until a mask is made to fit the patient's face. The ends are pinned together and the mask is stuffed with cotton or a small towel to receive the ether. This inhaler gives results perfectly satisfactory and has the additional advantage of being clean.

To avoid the primary choking sensation in the application of ether, some operators, notably in England, start the anæsthesia by abolishing consciousness by means of nitrous-oxide gas or chloroform and continue it with ether. It is a custom in some American clinics to precede the ether narcosis with a hypodermic injection of morphine sulphate from half an hour to fifteen minutes before the anæsthesia proper is started. This is of doubtful value, however, as is the previous exhibition of chloral.

A procedure of decided value, however, is the previous spraying of the nose with a 10-per-cent. solution of cocaine. This method of procuring safety and freedom from the annoyances of ether narcosis was published by Rosenberg, of Berlin, in the winter of 1895. A fuller discussion of its features will be found below, and it will suffice to state at this point that the use of the cocaine spray is of the greatest advantage to the patient and to the anæsthetizer. Rosenberg has found that by spraying the nasal mucous membrane with the solution mentioned, inserting the nozzle of the syringe into each nostril alternately, the mucous membrane becomes anæsthetized in about three minutes and the anæsthesia lasts for half an hour. Should the operation not be completed by the end of that time, the spraying is to be practised again. Its advantages are that the safety of the ether narcosis is enhanced, there is no coughing, gagging, or vomiting, and the miserable after-effects of ether—headache, vomiting, and the clinging smell of ether—are entirely absent (*Berliner klinische Wochenschrift*, 1895, Nos. 1 and 2). That this is usually true has been verified by a number of observers in Europe and America. It goes without saying, however, that the ordinary care given a patient under anæsthesia must not be lacking.

The patient should lie in a recumbent posture, and this should not be altered to a sitting

posture unless the nature of the operation urgently demands it. The so-called Trendelenburg posture, much used at the present day in abdominal operations, is bad for the patient, though convenient for the operator. The abdominal contents are thrown against the diaphragm, and respiration is seriously interfered with, the patient always becoming cyanotic. If it *must* be resorted to, the body should be brought back to the horizontal position at the earliest moment.

Provided with a mouth gag, a tongue forceps, and hypodermic needles ready for instant use, the anæsthetist should pour about a fluidounce (30 grammes) of ether into his mask or cone. This is *gradually* brought toward the patient's face and finally made to cover his nose and mouth. The first few inhalations of the anæsthetic produce a choking sensation, but if the patient is spoken to encouragingly he can usually be induced to continue his deep inspirations without prolonged struggles.

Three periods are recognised in a general somatic anæsthesia by ether: 1. The period elapsing between the beginning of the anæsthetic inhalation and the initial vanishing of consciousness. 2. That from the end of the first, or primary, stage to the total abolition of consciousness. 3. The stage in which consciousness has ceased to exist. The primary stage is characterized objectively by a slightly livid hue of the face, a tenseness of the voluntary muscular system, and the presence of conscious acts and words. If the patient is told to count, he will be well understood for a time varying between one and four minutes, when the numbers will gradually be heard less and less distinctly: they become a mere mumble, and finally cease. Subjectively, this stage produces a light vertigo, a buzzing and singing in the ears, difficulty in hearing, a beating in the head, and, as the second stage is approached, a feeling of heaviness in the legs and feet and formication, beginning in the feet and rapidly spreading over the entire body. Anstey, quoted by Kappeler (*Anæsthetica*, Stuttgart, 1880), who studied the effect of ether upon himself, says that during the first stage he felt generally elated, had a desire to laugh, experienced a general bodily feeling of warmth, and was aware of a palpitation of the heart with increased frequency of the pulse-rate. Objects before him began to revolve, as in acute alcohol poisoning, he became incapable of guiding the movements of his hands, and felt a tremendous heaviness in all his extremities. The primary stage lapses almost imperceptibly into the *second* or *stage of exhilaration*. Its advent is manifested by an unusual rigidity of the muscles, not infrequently producing opisthotonos. Attempts are made by the patient to reach and grasp the ether cone, and to arise from the table. The hands and feet are kept in lively motion, though toward the end of this stage the movements are rarely correlated. The patient may laugh, cry, call aloud, swear, and scold. If the patient is a woman, it is well for the anæsthetizer to have a third responsible person present, as the patient may afterward accuse him of personal assault, a notion evolved from her ravings. There is always a profuse sweating in this stage of ether anæsthesia, which sometimes, however, amounts only to a mere perspiration. The face assumes a somewhat more reddish appearance, the eyeballs are rolled upward, the psycho-motor symptoms gradually pass away, and total unconsciousness and muscular relaxation become evident. The subjective symptoms of the second stage can not, of course, be described; but that they are strong, even violent, may be surmised. Patients undergoing ether narcosis are known to have had erections and emissions, to have urinated, to have bruised their fingers severely in grasping the edges of the table, and to have bitten their lips. The complete abolition of consciousness and will, together with the loss of muscular power, marks the invasion of the third, or final, stage of ether anæsthesia.

During these various stages it is rarely necessary to give more than the original dose of from half an ounce to an ounce of the narcotic; but in order "to keep the patient under," ether must be added to the receiving cone from time to time. The dose varies so much with the age and idiosyncrasies of individuals that no specific amount can be stated. The writer has seen a woman undergo a two-hour operation with two ounces of ether; but cases are not rare in which even children require enormous doses.

Flourens, quoted by Wood (*Therapeutics, Its Principles and Practice*, Philadelphia, 1889), states that the involvement by ether of the nervous centres is—first, the cerebrum, next the sensory centres of the spinal cord, next the motor centres of the cord, then the sensory centres of the medulla oblongata, and finally the motor centres of the medulla. This would correspond to the usual clinical manifestations caused by the inhalation of the drug. But it is no uncommon experience to find a patient with his corneal reflex gone make a decided struggle against the stretching of the sphincter ani, and it is not rare to see a female patient resist surgical invasion of the vagina after the abolition of the conjunctival reflex. For rectal, vaginal, and urethral interference, the anæsthesia must be pushed deeply.

The pupils during ether narcosis are generally contracted at first, but dilate a little after anæsthesia is established. They react to light throughout the entire narcosis. Wide dilatation, coming on suddenly, is a symptom of grave danger.

The pulse-rate is increased during the first few inhalations, but it gradually falls, and in the final stage approaches the normal rate. The arterial pressure is increased, too, by ether inhalation, and this is due in large part to the increased peripheral resistance caused by contraction of the capillaries. The simultaneously increased power of the cardiac beat assists this increase of pressure, which does not fall until there is beginning failure of respiration.

The effect of ether upon the respiration is manifold. At first the inspirations are increased in frequency and depth, but they gradually become shallower and shallower until in the third stage they again resume their deep

character and become stertorous. This is due in part to the saliva which lies in the pharynx, poured out abundantly through the action of the ether upon the salivary glands. When some of the saliva is inhaled, it calls forth a reflex cough. The ether cone should always be removed for a moment when coughing begins, to allow of a few whiffs of atmospheric air. It has been well established, though there are still some sceptics, that the immediate danger of ether lies in paresis of the respiratory centre in the medulla, and that the pulse continues to beat after respiration ceases. The practical value of this is that the respirations must be watched with exceeding care in an ether narcosis, and on the slightest sign of respiratory difficulty or insufficiency energetic measures must be called into requisition.

The bodily temperature falls from $\frac{1}{3}°$ to $1°$ F. (0·3° to 1·5° C.) during ether narcosis—an additional reason for warmly wrapping the patient and surrounding him with hot bottles or cans after the operation.

Unpleasant occurrences during ether anæsthesia are common, but they may almost always be met satisfactorily. Vomiting is a most frequent incident. Since the patient is supposed to have his stomach free of contents, food is rarely regurgitated. The vomited matter usually consists of mucus and bile; but for fear of inhalation with the next inspiration, the pharynx should be cleaned at once. The lower jaw is drawn forward by placing the thumbs on the facial surfaces of the superior maxillary bones and the index fingers at the angles of the lower jaw. A motion downward and forward suffices to bring the lower jaw beyond the upper one. The jaws are then quickly separated by the mouth gag and, the tongue being drawn forward, the pharynx is wiped out as thoroughly as possible with a sponge on a handle. Authorities differ as to the advisability of continuing the administration of ether immediately upon vomiting. But, since vomiting shows that the centre which controls it in the medulla is not fully anæsthetized, and since regurgitation of gastric contents is the one great symptom of returning consciousness, it seems proper and scientific to continue the exhibition of the drug. Certainly clinical experience defends the continuance of the inhalation; for the vomiting usually ceases when more ether is given. Immediately previous to vomiting there is always a fall in the arterial pressure, easily appreciated in the radial artery. Unless there is a simultaneous laryngeal spasm, it need arouse no apprehension.

Cardiac failure may manifest itself suddenly. There is an immediate change in the colour of the face; it becomes very pale or very livid. No time should be lost in lowering the head to admit as much blood as possible to the brain. The hypodermic needle must be used at once. An injection of $\frac{1}{20}$ of a grain of strychnine sulphate and 10 minims of fluid extract of digitalis or $\frac{1}{50}$ of a grain of nitroglycerin should be given immediately. Sylvester's method of artificial respiration should be resorted to and continued for hours if necessary. Electricity is valueless and only causes waste of precious moments. In a recent article Wood draws attention to the uselessness of hypodermic injections of alcohol and insists that "under these circumstances any good effect which would be obtained by alcohol would be more rapidly reached by the further administration of ether." While energetic measures are being employed, assistants can give rectal stimulants containing cardiac excitants.

Should the respiration fail simultaneously with the circulation or alone. as manifested by lividity of the face and the other obvious signs, the same means toward its re-establishment should be used. Atropine sulphate, $\frac{1}{120}$ of a grain, should be given subcutaneously and artificial respiration and cardiac stimulation be pushed as far as possible. In a most interesting little work (*Les Tractions rythmées de la langue*, Paris, 1894), Laborde has collected sixty-three cases of persons brought to life after seeming death by restoring respiration by rhythmic traction of the tongue. The method is indicated in all cases of sudden death, particularly from asphyxia, and the writer can add at least two cases of restoration after the suspension of respiration during ether narcosis, although the heart continued to beat.

Should the patient go into shock or suffer from severe hæmorrhage during the anæsthesia, these conditions should be treated on well-established and familiar principles. A procedure of almost priceless value in great loss of blood is the *intravenous* or *intra-arterial injection* of a normal saline solution (0·6 per cent.). For the technics of the infusion, see under TRANSFUSION.

During operations at night, the light must always be *above* the operating table. Ether is very inflammable and its vapour has ignited at a distance of three feet from a flame. Its specific gravity being high, the vapour falls in atmospheric air.

In the recovery from ether narcosis there are some conditions which require treatment. Vomiting is the rule, lasting in patients with irritable stomachs sometimes for days. It is said that smelling of acetic acid stops this vomiting. Ice bags and hot compresses may be laid over the epigastrium, and occasionally an ice bag at the nape of the neck is of value. All ordinary efforts should be used to quiet the stomach, but the vomiting is rarely a serious phenomenon. Even in abdominal operations the vomiting is not of grave consequence, for the patient gives up his gastric contents so easily that sutures or ligatures are in little danger.

Headache and hysterical symptoms accompanied by erotism and mental excitement, with delusions and illusions, are not infrequent among the after-effects of ether. These usually vanish rapidly and are to be treated symptomatically. Acute mania has followed the administration of ether, but is fortunately rare.

The one grave danger following ether in-

halation is the subsequent development of a broncho-pneumonia, rarely a lobar pneumonia. Whether it is an "aspiration" or "foreign-body" pneumonia, or whether it is caused by the inhalation, during coughing, of masses of saliva and mucus containing pathogenic germs, is as yet a matter of contention among pathologists. It is believed by some that the irritant action of the vapour alone upon the mucous membrane of the bronchioles is sufficient to cause a capillary bronchitis. In children and in the aged this is a particularly dangerous complication. Certainly, so far as prophylaxis is concerned, an antiseptic mouth-wash for two days before the operation might be useful.

Finally, the use of ether by inhalation is to be recommended for the severe *pains of labour* and for *puerperal eclampsia*. In the latter instance, chloroform would be indicated because of the usual severe coexistent renal disease, and should be elected.

Etherization by the rectum possesses a merely historical interest. The longer time required for the production of the anæsthetic state and the coincident irritation of the rectum, have consigned this method to oblivion.

Local Anæsthesia.—Ether spray, projected upon the skin in a continuous stream, produces anæsthesia by its rapid evaporation. For this purpose it may be used in opening abscesses, in puncture or aspiration of the thoracic or abdominal cavities, and for the performance of any minor operation. It is inferior to cocaine as a local anæsthetic, though it has been used in ablation of the breast and in the Cæsarean section. Its rapid evaporation has made it useful, too, in *earache*, in *nervous headache*, in *toothache* (when combined with camphor), and in *neuralgic affections*.

Subcutaneously, ether is indicated in any form of *collapse* where the heart's action is feeble, in the *intense depression* of some of the acute infectious diseases, and in *infantile convulsions*. Whenever there is *cardiac failure* from any cause—even in ether narcosis—a hypodermic injection of ether is a proper and scientific procedure.

Internally, ether has been recommended for *nervous headache*, *abdominal colic* of any kind, the *spasmodic vomiting of pregnancy*, and *sea-sickness*. It has been praised as an indirect agent for removing *tænia solium* and *ascarides* by narcotizing them, the patient afterward receiving a cathartic. Ether is best given by the mouth in ice-cold water or in capsules. Its dose is from ½ fl. drachm to ½ fl. oz.

In *pathological* and *histological* work ether is used in the hardening of specimens to be cut on the microtome, and, combined with an equal part of absolute alcohol, for making a solution of celloidin in which the specimen is to be imbedded. Its spray is useful in freezing fresh specimens to render them sufficiently hard to be cut at once.

In the examination of stomach contents, ether is valuable in dissolving out the organic acids present.

Ether vs. Chloroform.—It must be admitted that we have no anæsthetic agent at our command which is *absolutely* safe. Though sudden death is more common from chloroform than from ether, the latter agent is not guiltless. And, in fact, to those nearly related to the patient who has died under anæsthesia it matters little whether it was due to chloroform or to ether, to irritation of the trigeminus or of the vagus. It is well, therefore, that the dread of an organic anæsthesia of whatever nature exists in the profession, for to the conscientious physician this wholesome fear means added watchfulness and care for the beings submitted to his skill.

Both ether and chloroform produce profound changes in the system when given by inhalation. By ether, hæmoglobin is diminished and in blood previously diseased the red corpuscles undergo degenerative changes. By a prolonged anæsthesia the blood becomes decidedly deteriorated, an argument for rapidity of operation (Da Costa, *Medical News*, March 2, 1895). Chloroform causes a contraction of the red blood-cells, lessening their power of oxygen absorption.

While ether must be looked upon as a cardiac stimulant, chloroform is, beyond question, a powerful cardiac depressant, producing its effects probably upon the heart muscle. This would agree with the clinical history of cases in which, upon cardiac failure in chloroform narcosis, the heart muscle has failed to respond to mechanical irritation.

Upon the brain and nervous system both anæsthetics have a strong action. Upon the inhalation of either there is a momentary arrest of respiration. This is unquestionably due to a reflex irritation from the terminal branches of the trigemini, for it occurs on section of both vagi and does not take place experimentally when chloroform or ether is administered through a tracheal cannula. It can not, therefore, be due to a peripheral stimulation of the pulmonary inhibitory nerves. The action of ether upon the cerebrum has been outlined above; that of chloroform is similar, except that the excitement does not last so long and the subsequent anæsthesia is much more profound.

The safety of ether lies in the fact that it kills by *respiratory paralysis*, and hence always gives due warning. The danger of chloroform is that it is fatal by *cardiac arrest*, and hence comes suddenly. These statements hold true for the vast majority of cases, though the reverse has happened in some instances. It depends, too, upon the dilution of the chloroform vapour; if it is highly concentrated, stoppage of the heart may precede arrest of respiration; if it is given somewhat diluted, the heart and lungs may stop together; if it is administered in very dilute form, the heart may continue to beat after respiration has ceased. Energetic means may prevent a death threatened by asphyxia; but no methods known can cause a heart to beat when once that organ has ceased its rhythmic play.

But it would seem that after so long an experience—and so fatal a one—we could recognise the kind of case in which the person was likely to succumb to ether or to chloroform.

And perhaps we are making some advances in that direction. In the Vienna General Hospital, out of 2,000 annual autopsies, six are held on bodies of patients who have died at the beginning of or during chloroform anæsthesia. This excludes those cases of chloroform death in which there existed a previous heart or lung disease. A personal communication from Dr. Kolisko, Professor of Pathology at the University of Vienna, reads: "In these cases we *always* find the condition known as *habitus lymphaticus.* The nature of this condition is: 1. A *persistent thymus gland,* which has often become considerably enlarged through an increase of its lymphatic tissue. 2. *Enlarged lymph-glands.* 3. *Adenoid vegetations* in the pharynx, *enlarged tonsils,* and *enlarged follicles at the root of the tongue* and *in the pharynx.* 4. *Enlarged follicles in the intestines* and *in the stomach.* These conditions are accompanied by *acute dilatation of the heart,* with no changes in the muscle tissue or endocardium; or occasionally there is evidence of a previous cardiac dilatation marked by thickenings in the endocardium, but not recognised clinically. There is also very frequently found a *hypoplastic condition of the arterial system.*" The patients on whom these autopsies were held died at varying intervals during chloroform anæsthesia; but in all of them the death was attributed to cardiac syncope. It would seem, therefore, that in anæsthetizing patients of the lymphatic temperament or those in whom there is a previous history of heart disease or in whom lymphatic enlargement or adenoid vegetations exist, *chloroform should be rigidly excluded.* Very stout persons should be given ether by preference, if they can take it, since fatty infiltration of the heart has been found after prolonged chloroform narcosis. Patients with a history of rheumatism should be given ether when anæsthesia is necessary.

The sudden deaths caused by ether have nearly all occurred in patients who had some previous lung disease or some greatly enervating lesion, such as intestinal obstruction, tumors of the brain, carcinoma, or renal disease. There is such a difference in personal idiosyncrasy that it is difficult to formulate any rule. On general principles, however, it may be said that when a patient's condition is good—*i. e.,* when his kidneys and lungs are normal and his nutrition has not been too seriously impaired—he should receive ether. In the face of renal disease or bronchitis, ether becomes positively dangerous, and, though it may not kill at once, it is very apt to do so later. With either anæsthetic the surgeon must be willing to take some risk, though he should diminish that risk as far as his judgment and knowledge enable him to do so.

Mention was made above of the spraying of a 10-per-cent. solution of cocaine into the nose as a measure of safety in both ether and chloroform narcosis. Through anæsthesia of the peripheral branches of the trigemini no irritation can be carried by these nerves, and hence no reflex can be called forth by them. It was demonstrated twenty-five years ago and is believed to-day that cardiac and respiratory inhibition in anæsthesia are caused by a reflex stimulation of the vagus and inhibitory respiratory centre in the medulla oblongata, by an irritation of the terminal branches of the trigemini in the nasal mucous membrane. And it is quite possible that by his experiments Rosenberg has solved the problem involving the dangers of anæsthesia. Incidentally, it should be mentioned that cocainization of the nose was practised in New York by Dr. Felix Cohn in chloroform narcosis as early as in 1891. He used it in submucous resections of the sæptum, and observed that the anæsthesia was always without untoward incident. The real credit of the innovation belongs to him, though Rosenberg made the first publication of it.

Rosenberg estimates that the patient receives only about $\frac{1}{10}$ of a grain (0·006 grm.) of cocaine by means of the spray. This is certainly not sufficient to cause depression of the heart, and the amount can be more easily controlled than when the drug is applied on cotton.

It remains only to point out again that, because of their different physiological actions, ether is by far a safer anæsthetic in the majority of cases than chloroform; that the cases must be well and carefully selected and the keenest and most incessant watchfulness must be observed during a narcosis by chloroform or ether. Surgical anæsthesia has bestowed such priceless benefits upon suffering mankind and upon scientific medicine that it is unfortunate that its virtue should be sullied by its occasional slips.

[The Br. Ph. still makes a distinction between *æther,* for internal administration in doses of from 20 to 60 minims, and *æther purus* (the equivalent of the *æther fortior* of the U. S. Ph. of 1880), for inhalation. The *spiritus ætheris* of the U. S. and Br. Ph's, a mixture of ether and alcohol, may be given in doses of from 30 to 90 minims. The *spiritus æthereus* of the Ger. Ph., which is somewhat weaker, may be given in doses of from 40 to 100 minims. The dose of *spiritus ætheris compositus* (U. S. Ph., Br. Ph.), commonly known as *Hoffmann's anodyne,* is from $\frac{1}{2}$ to 2 fl. drachms. The Hoffmann's anodyne of the Fr. Cod., *æther sulfuricus alcoolisatus,* resembles more the *spiritus ætheris* of the U. S. and Br. Ph's, but is stronger; it may be given in doses of from 20 to 60 minims.]—Samuel M. Brickner.

ETHOXYCAFFEINE.—This ethoxyl addition compound of caffeine, $C_{10}H_{14}N_4O_3$, is said to be more active than caffeine. It has been used in *migraine* in the dose of 4 grains, which should not be exceeded, as a larger amount is apt to cause vertigo and nausea.

ETHYL BROMIDE, C_2H_5Br, *hydrobromic ether, æther bromatus* (Ger. Ph.), was discovered in 1827 by Sérullas, who prepared it by combining bromine with alcohol in the presence of phosphorus. It is a colourless, very volatile, not inflammable liquid, with high refractive powers. It has an agreeable odour and tastes hot and sweet. Its specific

gravity is 1·450, and it boils at a temperature a little higher than that of the body. It is very slightly soluble in water, freely soluble in alcohol and in ether.

In 1880 and 1881 it was regarded in the United States as the best and safest anæsthetic for surgical purposes, but several disastrous results from its administration caused it to fall into disuse. Recently it has again been recommended in oto-laryngologic practice and is particularly praised for use in children. Cumston (*Boston Med. and Surg. Jour.*, Dec. 20, 1894) praises its use highly on an experience based on over two hundred cases. According to this writer, the drug should be administered only when it is colourless, extremely volatile, and of a sweet and ethereal odour. The dose varies from 3 to 6 fl. drachms, depending on the age of the patient, given by inhalation. The entire dose should be given at once and should not be repeated. Air must be rigidly excluded. The drug is contra-indicated when organic lesions of the heart, lungs, or kidneys are present.

The fatal cases, however, have made the drug unpopular among surgeons, though it has been lately pointed out that the bad effects may have been due to impurities. Bromide of ethyl kills either as a chemical compound or by decomposition in the body. Squibb has called attention to the fact that the danger of anæsthetics is in proportion to the toxicity of their elements; and this dictum would make ethyl bromide more than twice as dangerous as chloroform. On account of its high volatility, it can not be used for prolonged narcosis (one minute), and one, certainly, among the reported deaths caused by it was due to syncope. It kills as chloroform kills—by cardiac arrest.

The advantages alleged for ethyl bromide are its agreeable odour, though it is somewhat alliaceous, its non-inflammable character, the slight tendency to headache and vomiting which it produces, the absence of salivation and bronchial irritation, its rapid elimination, and the quick recovery from its effects.

In its administration the same care as to position, unimpaired respiration, and absence of food from the stomach must be observed as in the use of ether and chloroform. Locally, it has been used for anæsthesia in the form of a spray, taking from two to three minutes to freeze the parts. The drug has been said to be efficacious, given internally in doses of from 5 to 30 drops, for *neuralgia*.

[Ethyl bromide must not be confounded with ethylene bromide.]

Samuel M. Brickner.

ETHYL CHLORIDE, *chloride of ethyl, hydrochloric ether*, C_2H_5Cl or $CH_3.CH_2Cl$, is a thin, colourless liquid, highly inflammable. It has an ethereal odour and when first taken into the mouth has a saccharine, aromatic, and afterward an alliaceous taste. It has a specific gravity of 0·9214. Ethyl chloride is very volatile and must be kept in tightly stoppered glass bottles.

The drug has had a limited use as an anæsthetic. Because of its great volatility it is not available for general anæsthesia, since the lungs throw off volatile gases very rapidly. It causes, when inhaled, a marked fall in the pulse-rate and a diminished force in the blood-pressure. The respirations, after toxic doses, are increased in rate and in depth. Cardiac and respiratory movements cease simultaneously when the drug is experimentally pushed to its limit.

The rapid volatilization of ethyl chloride has given it some use in minor surgery. For this purpose it is sold in the market in glass bulbs with a tip hermetically sealed. When the drug is to be used the tip is broken and the point of the bulb held a few inches from the area it is desired to anæsthetize. The warmth of the hand is sufficient to cause the liquid to expand and a tiny jet is thrown on the skin. By its rapid vaporization the area soon becomes frozen. In this way it may be used to open abscesses, remove ganglia, or incise a small area of skin for any purpose.

Internally, it has been used as a stimulant in doses of from 10 to 30 drops. When it is thus administered, a solution of it in an equal amount of alcohol is prepared.

Samuel M. Brickner.

ETHYLENE BROMIDE. — This compound, also called *dibromethane*, is an oily liquid having the smell and taste of chloroform. It has been used in *epilepsy*, but it is not apparent that it is preferable to other bromides. The dose for an adult is from 5 to 10 drops three times a day.

ETHYL IODIDE, or hydriodic ether, C_2H_5I, a highly volatile liquid, has been used by inhalation (of the vapour of from 10 to 15 drops) in subacute and chronic *bronchitis* and in *asthma*. It is said to be a powerful anæsthetic.

ETHYLPHENACETINE. — See under Phenacetine.

EUCALYPTEOL.—Under this trade name eucalyptene hydrochloride has been recommended as an internal antiseptic. The daily amount for an adult, best given in capsules and in divided doses, is 20 grains.

EUCALYPTOL (U. S. Ph.).—See under Eucalyptus.

EUCALYPTUS.—This tree is a tall evergreen indigenous to Australia. While as a rule the leaves of *Eucalyptus globulus* are used for pharmaceutical purposes, the oil in the market is obtained indifferently from *E. amygdalina, E. citriodora, E. dumosa, E. hæmastoma, E. mannifera, E. oleosa, E. piperita, E. resinifera, E. staigeriana*, and *E. viminalis*. The idea was at one time entertained that because the tree grew easily in marshy districts and drained the soil of water it would be an excellent means to diminish *paludism* in damp, low-lying regions. With this end in view extensive plantations of eucalyptus were instituted in the Roman Campagna, but it is said that Campagna fever has not diminished in consequence, although it was supposed that the volatile exhalations from the tree would act as a prophylactic. It may be understood, thanks to the discoveries of Laveran, why euca-

lyptus plantations have not stopped the appearance of paludal fever in the Campagna, for, while the researches of Chadwick have established the fact that the lowering of the height of the subsoil water is related to the health of the residents on the soil, Laveran's researches have shown that the organism which causes paludal fever is, in all probability, introduced into the human organism in food or drink. Therefore it is unlikely that planting eucalyptus trees will ever accomplish anything, from a sanitary standpoint, except the disposal of a portion of the ground water.

The leaves have an odour like camphor and a pungent, bitter taste. They contain chlorophyll, resin, tannin, some inert substances, and a volatile essential oil, *oleum eucalypti* (U. S. Ph., Br. Ph.), which may be distilled from the fresh leaves.

Eucalyptus oil is imported from Australia and Algeria, and is a faint yellow, sometimes colourless liquid, which has a characteristic aromatic odour and a pungent, cool taste. It is soluble in alcohol and in carbon disulphide. By fractional distillation the oil may be separated into *cymene*, $C_{10}H_{14}$, *eucalyptene*, $C_{10}H_{18}$, a terpene, and *eucalyptol*, $C_{10}H_{18}O$. The value of the oil depends upon the percentage of eucalyptol present in it. Eucalyptol is a colourless liquid which has a strong aromatic, camphoraceous odour, and is slightly soluble in water, but easily soluble in alcohol.

Like most of the essential aromatic oils, eucalyptus oil is a germicide and in sufficient strength it inhibits the growth of micro-organisms in culture fluids. Applied externally, the oil is an irritant and causes vaso-motor dilatation. When it is inhaled the pungent aromatic odour increases the flow of saliva and stimulates the bronchial secretion. When it is administered internally there is a feeling of warmth in the stomach, and in large doses there are rapid pulse, general excitation, and restlessness, which are followed by a decrease in arterial pressure, a diminution in temperature, irregular respirations, muscular weakness ending in paralysis, and finally death. Moderate doses sometimes cause gastro-intestinal disturbances and symptoms of renal and cerebral congestion.

Internally, its stimulating effects increase the flow of the gastro-intestinal fluids, and there is said to be an increased excretion of urea. Eucalyptus is largely excreted by the bronchial mucous membranes, the kidneys, and the skin.

Oil of eucalyptus has been used as an antiseptic in the treatment of *wounds* and *ulcers*. It is applied in some alcoholic menstruum, or in an ointment. The latter, *unguentum eucalypti* (Br. Ph.), is made by incorporating 1 part of oil of eucalyptus with 2 parts each of soft and hard paraffin. Or the fluid extract, *extractum eucalypti fluidum* (U. S. Ph.), tincture or water of eucalyptus, may be applied, but all these preparations are inferior in value to the oil or to eucalyptol.

Internally, oil of eucalyptus has been administered in the treatment of paludal fevers, but early experience showed that in therapeutic value it was inferior to quinine, and there has been no later evidence to prove that during its administration there is a decrease of the *Hæmatozoon malariæ* in the blood. It is inferior to arsenic in relieving chronic malarial poisoning, such as toxæmia associated with asthenia and the characteristic cachexia, or enlarged spleen.

In *acute* and *chronic bronchitis* oil of eucalyptus or eucalyptol is useful as a stimulating expectorant and local antiseptic.

In *asthma* cigarettes made from eucalyptus leaves, or inhalations of steam and eucalyptol, are said to afford relief from the paroxysms.

Some observers have reported that it is useful as an intestinal antiseptic; either the oil or eucalyptol may be administered in capsule in *gastric* or *intestinal catarrh*, in *enteritis*, and in *typhoid fever*.

While it has been administered in *pyelonephritis* and in *chronic cystitis*, it is not so useful as some other remedies.

Dr. E. H. Brown has used eucalyptol alone in treating *cholera*, giving doses of 5 minims to adults and from ½ to 1 minim to children, in a little milk, every fifteen minutes for an hour, and then every hour.

A number of observers have reported that oil of eucalyptus, in doses of 5 minims given from four to six times daily, relieves *headache*, especially that due to malaria or congestion.

Dr. W. W. Hardwicke has treated *pertussis* successfully with a spray composed of a mixture of 2 fl. drachms each of oil of eucalyptus and terebene and 1½ fl. oz. of alcohol. This was used half an hour before each meal and at bedtime.

Mr. J. B. Curgenven administered oil of eucalyptus internally in *scarlet fever* in frequent doses of a few drops shaken up with water. He also advised that the clothing, sheets, and pillows should be sprinkled with the oil, and that the body should be sponged twice daily with an emulsion of the oil and water of the strength of ½ fl. drachm to 1 fl. oz. He found that the eruption was arrested, the temperature was reduced, the angina was relieved, and the enlarged glands decreased in size. In patients so treated there was no albuminuria. Curgenven held that if this treatment was begun sufficiently early the disease would be aborted, and that the oil would act as a prophylactic if administered to susceptible persons who were exposed to scarlet fever.

Dr. Germain Sée has reported that while simple inhalations of creosote or of eucalyptus are without effect in the treatment of *pulmonary tuberculosis*, if a patient so affected passes several hours daily in a pneumatic cabinet in which the compressed air contains the vapour of a mixture of creosote and eucalyptus oil, there is a return of appetite, with improvement of the general symptoms, even in advanced cases of phthisis.

The dose of the oil is from 1 to 20 minims, and that of eucalyptol from 1 to 15 minims.

M. Anthoire has obtained by treating oil of eucalyptus with hydrochloric acid a white micaceous scaly substance that he called *eucalypteol*. Its odour resembles that of camphor and

it has a slight peculiar but persistent taste. It is almost insoluble in water and in glycerin, but freely soluble in alcohol, in ether, in chloroform, and in fixed and volatile oils. It is not poisonous, is tolerated by the stomach, and is principally eliminated by the bronchial and salivary secretions and in part by the urine.

It is said to exercise an antiseptic and disinfectant action on the secretions of the bronchial and intestinal tracts. It has proved useful in *acute* and *chronic bronchitis* in doses of from 15 to 20 grains a day.

W. M. Russell has reported that the gum of *Eucalyptus rostrata* in doses of 1 grain, in troches, taken three or four times a day, relieves the distressing vomiting of *seasickness*, especially in the cases of delicate or strumous women.—SAMUEL T. ARMSTRONG.

EUGENIC ACID, EUGENOL, $C_{10}H_{12}O_2$, is a colourless, oily liquid obtained by the oxidation of oil of cloves. It has been used as an antipyretic in daily amounts of 12 grains, but is chiefly employed by dentists as an antiseptic and local anæsthetic.

Iodized eugenol, a yellowish, tasteless compound, has been used as a substitute for aristol.

Eugenol acetamide, a crystalline compound, has been employed as a local anæsthetic, especially in dentistry. Applied dry to a mucous surface, it produces anæsthesia of the parts with which it comes in contact, and without producing irritation.

EULACHON OIL, obtained from the candle-fish (*Thaleichthys pacificus*), has been recommended as a substitute for cod-liver oil.

EULYPTOL.—This preparation, said to be a mixture of 6 parts of salicylic acid and 1 part each of carbolic acid and eucalyptus oil, has been recommended as an energetic antizymotic.

EUONYMUS (U. S. Ph.), *wahoo*, the root-bark of *Euonymus atropurpureus*, is employed as a cholagogue. The *extractum euonymi* may be given in doses of from 1 to 3 grains. A bitter principle, known as *euonymin*, found in the bark, is used in cases of *torpor of the liver*, in doses of from ½ to 3 grains.

EUPATORIUM (U. S. Ph.).—The leaves and flowering tops of *Eupatorium perfoliatum*, thoroughwort, are used mostly as a domestic remedy, in warm infusion, in the initial stage of acute febrile affections, in which they act as a diaphoretic. In large doses, eupatorium is emetic and cathartic. The fluid extract, *extractum eupatorii fluidum*, may be given in doses of from 20 to 60 minims.

EUPHORBIA.—The roots of *Euphorbia Ipecacuanha* and of *Euphorbia corollata* are recognised under this title. The former variety has many popular names, of which the commonest are ipecac spurge and American, Carolina, or white ipecac, while the latter is known as wild ipecac, milk purslain, and snake milk. The root of each is a harsh and irritating emeto-cathartic and entirely improper to use if anything else can be found. As a cathartic, the dose is 20 grains; as an emetic, 10 grains; and as a diuretic, 5 grains. The diuretic property is not very well marked, and euphorbia has rarely been used to increase the flow of urine.

Euphorbia heterodoxa.—See ALVELOZ.

Euphorbia ocellata and **Euphorbia prostrata** are employed in the Western States to prevent the effects of the *bites of poisonous snakes*.

Euphorbia hypericifolia and **Euphorbia maculata** are somewhat astringent and have been employed in *dysentery*, *diarrhœa*, *leucorrhœa*, and *menorrhagia*.

Euphorbia pilulifera, the pill-bearing spurge, is found in Australia, Oceanica, and tropical America, and has some local reputation in the treatment of *asthma*, *dyspnœa*, and *chronic bronchitis*. It appears to act more as an antispasmodic than as an expectorant. An infusion of a drachm of the stem and leaves in a pint of water may be given in almost any desired quantity, and an unofficial extract, tincture, and fluid extract are made, of which the doses are respectively from ½ to 1 grain, from 10 to 30 drops, and from ½ to 1 fl. oz. In whatever form it is used, it must be employed for several days before any benefit is obtained.

Euphorbia chilensis is sometimes used in Chile, where it is found, as a drastic cathartic. It is very harsh in its action.

Euphorbia resinifera furnishes the *euphorbium* of the Ger. Ph.

RUSSELL H. NEVINS.

EUPHORBIUM (Ger. Ph.) is a gum resin obtained from *Euphorbia resinifera*, a plant found in northern Africa. Externally, it is a powerful irritant to the skin and mucous membranes of the eyes and air-passages, resembling in its action that of horseradish, but its effects are more marked. Internally, it is a strong hydragogue cathartic and was used as such in the past, but is now entirely abandoned on account of its harsh and irritating properties. In large doses it causes emetocatharsis, and severe enteritis has sometimes followed its use. As a counter-irritant and rubefacient its effects are very similar to those of mezereon, but it is rather more vigorous in its action. It is sometimes used as an application to stimulate *indolent ulcers* and *unhealthy suppurating surfaces* and to prolong the suppuration caused by cantharides. For such purposes an ointment containing about 1 part of the drug in 20 is the form in which it is ordinarily employed. The suppuration caused by setons and issues may be prolonged and increased by any of the ointments containing this drug or by its application in the form of a powder. The fresh juice and the powdered plant have the same properties as the resin, but are not so convenient to use and not so easily obtained.

RUSSELL H. NEVINS.

EUPHORIN, or *phenylurethane*, is a phenylcarbamate of ethyl or carbanilic ether, and is formed by the action of chloride of ethyl on aniline. It occurs as a white crystalline powder which has a faint, aromatic odour and a taste that is scarcely appreciable at first, but subsequently resembles that of cloves. It is

almost insoluble in cold water, but is soluble in hot water and in alcohol.

Administered to animals in very large doses, it produces anæsthesia, abolition of the reflexes, progressive weakness, and collapse. Giacossa found that a 2-per-cent. solution very distinctly hindered or altogether arrested the growth of micro-organisms.

It has been used as an antizymotic and germicide in lieu of carbolic acid, although its germicidal power is inferior to that of the acid. C. Curtis, Cao, and Graeomeni hold that as an antipyretic it is as rapid and energetic in its action as antipyrine, acting better when the *fever* is at its maximum and during the early stage of defervescence than before that. As an antipyretic it acts in from half an hour to two hours, and its effects last from three to ten hours. There is a feeling of warmth and moderate sweating during the defervescence, and when the temperature rises again the rigour is not severe. It may produce cyanosis, but does not cause collapse, and it may be used instead of any other antipyretic when a marked reduction of temperature is required. It is a useful antipyretic in *surgical fever*. It is an excellent antirrheumatic, as its action is certain in either *rheumatic fever*, *chronic articular rheumatism*, or *muscular rheumatism*. Where there are pain and swelling these symptoms are relieved.

It is recommended as an analgetic in *migraine*, *sciatica*, and *supra-orbital* and other forms of *neuralgia*.

Cao states that it is as effective as iodoform and less toxic, and Curtis asserts that as an antiseptic its action is intermediate between that of carbolic acid and that of mercuric chloride. It has been used with success as a local disinfectant in *aphthous stomatitis*, in *burns*, in *herpes*, in *venereal ulcers*, and in various *skin diseases of parasitic origin*. L. M. Bossi considered that applications of euphorin powder promoted healing after the suture of a lacerated perinæum; he recommended insufflation of the powder for the treatment of *elytritis* and *uterine endotrachelitis*, and in *endometritis* he used intra-uterine pencils containing from 40 to 50 per cent. of euphorin. Bergerio used the powder or an alcoholic solution successfully in treating *ulceration of the cervix uteri*.

The dose is from 1 to 7 grains, in a capsule or wafer or dissolved in sherry wine.

SAMUEL T. ARMSTRONG.

EUROPHENE, or *europhen*, as it is often written, diisobutylorthocresoliodide, $(2\left(\begin{matrix}C_4H_9\\CH_3\end{matrix}\right.C_6H_3O)HI)$, is a fine, amorphous powder, light yellow in colour, made by the action of iodine upon isobutylorthocresol in a potassium-iodide solution. Its odour is aromatic and is thought to resemble that of saffron. It has no taste. It is soluble in alcohol, in ether, in chloroform, and in oils, but is insoluble in water and in glycerin. Europhene is permanent in the dry state, but on prolonged contact with moisture it is decomposed with an evolution of free iodine. If heated to 158° F. in the presence of water, it is in like manner decomposed, and for this reason heat should not be employed in making solutions of it. The amount of iodine which europhene contains is said to be 28·1 per cent., and it is to the fact that it yields this iodine on exposure to moisture that it owes its therapeutical value. Europhene is similar in its actions to iodoform, and has the great advantages of having a less disagreeable odour and of parting with its iodine less rapidly, and hence of being less poisonous. It is also less likely to cake than iodoform is, and is much lighter. So far as the antiseptic properties of europhene are concerned, they are not more pronounced than those of iodoform.

The therapeutics of europhene is the same as that of iodoform. Like iodoform, it may be applied in powder and adheres well to wounds and mucous membranes. It is also applied in an ointment the strength of which usually varies from 1 to 10 per cent., according to the circumstances of the case. It is in various forms of *ulceration* that europhene manifests its greatest usefulness, and especially in *chancroid*, *chancre*, *condyloma*, *scrofuloderma*, and *lupus*. Applied to *burns*, it is of considerable service, and for this purpose a dressing consisting of 3 parts of europhene and 7 of olive oil has been suggested. As europhene becomes active only in the presence of moisture, its good effect when applied to secreting surfaces is easily understood, and for the same reason it might be supposed that, applied in skin diseases of a dry and scaly character, it would be inactive. This indeed seems to be the case, for, though it has been said by one reporter to be the equal of chrysarobin in *psoriasis*, by far the greater number of observers have found it valueless in that disease. Its value, too, in *eczema* and *favus* is slight. Europhene may be used by nasal insufflation, and for *catarrhal conditions* and for *ozæna*, also as an application after operations it is often serviceable. As an application to *syphilitic ulceration* of the nasal passages it is excellent, and has been thought of some service in *epistaxis* from septal erosion. The remedy has also been used for *laryngeal tuberculosis*, as well as for a variety of morbid conditions of the eye and ear. Europhene is not generally given by the mouth, though 15 grains so administered are said to have produced no result. This is not surprising, however, for it is believed to be little absorbed, by far the larger part passing through the alimentary canal unchanged. The attempt has been made to treat *syphilis* by hypodermic injections of an oily solution of europhene, but the success has been slight. The solution so used usually contains from 3 to 10 per cent. of europhene in olive oil. Of this the hypodermic dose contains from ½ to 1½ grain. In combining europhene it must not be forgotten that it is incompatible with metallic oxides, salts of mercury, and starch.—HENRY A. GRIFFIN.

EVACUANTS.—Remedies or measures which promote the discharge from the body of any of its normal secretions, such as sternutatories, sialagogues, expectorants, emetics, cholagogues, cathartics, diaphoretics, and diu-

retics, are as a matter of convenience grouped under this head.—Russell H. Nevins.

EXALGINE, orthomethylacetanilide, or methylacetanilide, $C_9H_{11}NO$, is one of the three methyl derivatives of acetanilide, and is made by warming together monomethylaniline and acetyl chloride. It occurs in long acicular or tablet-like crystals that are obtained by crystallization from a solution or from a mass after fusion. It is sparingly soluble in cold water, but more soluble in hot water, and readily soluble in dilute alcohol.

Brigonnet, its discoverer, found that hypodermic injections of exalgine in the lower animals produced epileptoid convulsions, respiratory disturbances, a fall of temperature, and cyanosis due to alterations of the blood, which became prune-coloured and contained methæmoglobin. There was circumscribed muscular paralysis at the point of injection. Marandon de Montyel (*Tribune méd.*, June 9, 1892) found that in man it had little action on the digestive system, though it caused a bitter taste in the mouth and an increased flow of saliva, accompanied with a feeling of tightness in the region of the stomach. If it was administered with food these symptoms were absent. While large doses in animals did not produce albuminuria or hæmaturia (Brigonnet), in man the quantity of urine was decreased, the colour became darker, and urabilin and indican were present if the dose was large. Occasionally there was a slight fall of arterial pressure, though usually there was a rise with a decrease of the pulse-rate. Large doses produced vertigo, amblyopia, tinnitus aurium, headache, vaso-motor disturbances that were manifested by sweating, circumscribed hyperæmia or cyanosis followed by pallor, and trophoneuroses, such as formication, or local or general sensations of heat or cold. The brain seemed to be the first organ affected and the first to recover.

No fatal poisoning has been reported as consequent upon the adminstration of toxic or large doses of exalgine, although it has caused general motor paralysis with dyspnœa, intense pallor, palpitation, and physical prostration.

Therapeutically, de Montyel found that it improved intellectual and sensory disturbances of reflex origin in some persons, while in other individuals analogous conditions were aggravated. It resembles antipyrine in its action, though its operation is prompter and sometimes more fugacious. It is more popular as an analgetic and antispasmodic than as an antipyretic. In all forms of *neuralgia* it acts promptly and effectively. Moncorvo and Dana have used it successfully in *simple chorea*, and Dana considers that it is a specific in doses of from 3 to 5 grains three times a day; where there is anæmia iron is given with the exalgine. Dr. John Gordon found it beneficial in *nervous headache*, *lumbago*, the *lightning pains of tabes*, and *gouty arthritis*. Dr. E. G. Younger, of London, found that it relieved the *headache* and *insomnia* in cases of hopeless insanity characterized by *melancholia*.

The dose is from 1 to 4 grains every two to four hours, until the symptoms are relieved, when it is administered less frequently. It is best given in capsule or in sherry or whisky.

[According to Dr. James T. Whittaker, of Cincinnati, exalgine has the peculiarity that in small doses it allays pain without affecting the tactile sense. He thinks it is not to be recommended as an antipyretic, but says that as an analgetic, in doses of from 3 to 5 grains, it often shows surprising effects, especially in *neuralgias*, the *pains of tabes*, *angina*, *hemicrania*, *sciatica*, and various forms of *neuralgia* and *rheumatism*. Dr. Thomas D. Savill, of London (*Lancet*, Dec. 25, 1893), has used exalgine in a number of cases, not so much as a curative agent in neuralgia and allied disorders of the nervous system as in the endeavour to relieve the pain associated with various chronic maladies. He gives accounts of twelve cases, in all of which the symptom for which exalgine was administered was pain, varying in situation, constancy, character, and intensity. In many of the cases it was situated in the head, and was of a more or less neuralgic character. In four cases the pain complained of was in the hips, and in only two of these was any improvement noted. In the other cases the pain was referred to the skin, corresponding more or less with the distribution of a particular sensory nerve. In six of the cases where the cause of the pain was persistent the dose had to be increased, and exalgine did not seem to be altogether free from the disadvantages that attend the use of all drugs of this class—viz., the necessity of increasing the dose or of changing the remedy from time to time. All the patients had been in the infirmary for some time, so that their relief could not be due simply to their improved surroundings. Dr. Savill thinks one is justified in expecting that in exalgine there exists a valuable analgetic specially adapted to relieve pains of a neuralgic type, being prompt and efficacious in its action and without any of the deleterious after-effects observable with some of the other drugs belonging to the same chemical group, but of which the dose requires to be occasionally increased if the drug is continued for a long period.

Dr. P. Cesaris now finds that exalgine readily dissolves in a solution of sodium salicylate, and suggests the following formula:

Exalgine..................	1·0 part;
Sodium salicylate.........	1·1 "
Distilled water............	10·0 parts.]

Samuel T. Armstrong.

EXCITANTS are remedies which arouse and stimulate action, and especially nerve action. This excitation may be the result of stimuli applied directly and locally, as occurs when the electric current is used to act upon individual nerves; it may occur reflexly, as is seen in the stimulation which follows the dashing of cold water on the face or chest; and, finally, and most important of all, it marks the therapeutical effect of systemic remedies such as caffeine and alcohol. Of remedies which may act to produce local or general excitation there is a large number,

among which are electricity (both galvanism and faradaism, but especially the latter), heat, however employed, cold if externally applied for brief periods, alternations of heat and cold, counter-irritation, ammonia, alcohol, ether, caffeine, coffee, tea, cocaine, nux vomica, strychnine, belladonna, ergot, digitalis, and strophanthus. Beside these there are many agents which to some degree cause nerve stimulation, but the more powerful excitants, as well as those most frequently employed, are mentioned in the list I have given. So far as the clinical applications of excitants are concerned, they are many and varied, and, whether the stimulation is systemic or merely local, the action is essentially the same, for it is an excitation. *Shock*, *collapse*, and their allied conditions of *nerve exhaustion*, as well as *narcotic poisoning* with its nerve depression, offer the conditions which most commonly demand systemic excitation, and therefore which are most often treated by excitants. For such conditions the remedies already mentioned may be employed according to the demands of the individual case. Of local excitants electricity and counter-irritation are the best examples, though the uterine stimulation which follows the internal administration of ergot must in a sense at least be considered local. The conditions remedied by local excitation are many, but their therapeutics is more properly considered elsewhere.—Henry A. Griffin.

EXERCISE.—The special endowment of muscular tissue is contractility in response to stimulation. Whether the latter is mechanical, chemical, thermic, electric, or physiological, the reacting muscular fibres become shorter and thicker, and the muscle, composed of many bundles of fibres bound together and packed in their sheaths, contracts as a whole, its ends are approximated, and the bony levers, which give attachment to the tendons, are moved. This is the usual arrangement of those muscles which are under the control of the will, but the unstriped, involuntary fibres encircle the lumen of the blood-vessels and hollow viscera; when stimulated they constrict the calibre of the tube and compress or propel any contained fluid or substance. Movement is thus the physical expression of exercise, the latter term denoting the functional activity of the neuromuscular apparatus. The nervous and muscular systems have been called the master systems of the body, since the remaining organs and systems exist to prepare and distribute their nourishment and to remove their waste. In the simplest forms of animal life there are no organs, but the undifferentiated protoplasm is irritable, contractile, assimilative, and reproductive. As the scale of animal life is ascended, increasing complexity of function necessitates increasing differentiation and specialization of tissues and organs, and it is the office of the neuromuscular apparatus to convert and distribute the potential energy in the oxygen of the respired air, and in the assimilable parts of the food, so as to adjust the organism to its varied and changing environment. Anatomically, muscle and nerve are intimately connected, and physiologically they act as one apparatus.

This neuromuscular apparatus consists, in its simplest form, of a nerve-centre connected on the one hand with a receptive sensory surface, on the other with a muscular fibre, by means of conducting nerve filaments. Such an arrangement is called a reflex arc, and when a sensory impression is conveyed to the nerve-centre it provokes an explosion in the unstable protoplasm of the cell, whose energy is transmitted in some form to the muscular fibre, and effects there an explosion of a different kind, resulting in its contraction. Such a movement is called reflex, and seems to be the type and basis of most muscular activity. Practically a reflex arc is composed of many connected centres and many muscular bundles, and different arcs are so joined that movements of great complexity may be purely or mainly reflex in character. Those muscles whose contraction can be evoked or modified by the will are called voluntary muscles, and the willed movements, voluntary movements. Their corresponding reflex centres are connected with the volitional cortical centres of the brain. Probably, in response to past or present sensory stimulation, these exercise a controlling or modifying influence upon the lower centres and upon the muscular movements over which they preside. Starting at an unexpected noise, winking when an object is suddenly thrust near the face, sneezing, and coughing, may be purely reflex acts of voluntary muscles, but they are ordinarily more or less subject to volitional modification. Rhythmically recurring reflex movements, like breathing and cardiac pulsation, are often termed automatic. Not only movements responding to a sudden sensory shock are reflex, but a large proportion of the movements of every-day life, and especially habitual and practised movements involving repetition, like chewing, talking, walking, swimming, and the movements of the arts and trades, once they are thoroughly acquired, are largely reflex, volition serving mainly to start and stop them and to modify their rhythm. Volition enters into such movements in varying degree, according as they are movements of premeditation, emergency, or habit, and may restrain as well as urge. The oftener a movement is repeated under similar conditions, the less will be the voluntary element, and the greater the reflex element, having its seat in the lower, and especially in the medullar and spinal centres. Besides reflex and voluntary movements, there are those produced by direct stimulation of the muscle itself, or its motor nerve; such movements elicited by electricity and massage and the application of heat and cold are often therapeutically utilized.

Passive movements are those which the body or some of its members receive through some external agent, as a power apparatus or the hand of a manipulator.

All these forms of movement, except the voluntary, take place as well in the unstriped or involuntary muscular fibres, and this form of exercise, from its practical bearing, is worthy of more attention than it usually receives. The

training of the vascular and visceral muscular fibres by the application of hot and cold water to the skin, its exposure to air of varying temperature and moisture, and the application of massage and electricity—in a word, vascular and visceral "gymnastics"—is a mine of hygienic and therapeutic resource to those who appreciate its importance. The movements of the skeletal muscles themselves are indeed a most powerful stimulus to these vascular and visceral fibres, since they exert a real massage on the surrounding tissues and neighbouring organs, improve their circulation and nutrition, and stimulate them to activity.

If muscle should lose its contractility, volition and feeling would be powerless to express themselves, the respirations and heart beats would cease, and the vessels and organs lie flaccid and without adjustability; stimulation through the different senses would remain without visible result. On the other hand, every muscular contraction is reported back to the nerve-centres through the afferent nerves, is there registered, and helps to form that background of sensory experience by which our mental processes are so largely conditioned. The muscles are the servants of the will, and of those reflex and automatic centres upon which the fundamental processes and reactions of the body depend, as soldiers obey their superior and petty officers; but the muscles also contribute in a very important degree, by their varying and correlated activity, to the stimuli reaching and modifying those centres, as the general and his staff base their orders upon the reports of subordinates as to the condition of the army and of the surrounding country. Muscular movements in this and other ways determine mental states and processes, and actively modify consciousness, temperament, and character. The gross structure of the brain is to an appreciable degree determined by muscular activity, since, if a limb is lost or paralyzed, the corresponding motor areas are atrophied, and actually smaller. Besides the vast direct influence of muscular movements upon the brain and mind, they have important collateral effects, through widening the mental horizon. The writer has several times observed children who had been for years unable to walk on account of *infantile paralysis*, and were shy, reticent, and phlegmatic, in consequence of their helplessness, undergo a sudden change in disposition, becoming bright, lively, and talkative, after acquiring the power of locomotion by appropriate treatment.

Always bearing in mind the peculiarly intimate relation between the muscular and nervous systems, and their reciprocal reactions, further examination shows that the effects of muscular contraction are manifest in nearly all the tissues and organs of the body. In the muscle itself functional activity produces heat, work, a sound, and certain chemical and electrical reactions. There is a greater flow of blood to the working muscle; absorption of oxygen and nutritive material is increased; tissue changes and the formation of waste are accelerated. Muscular irritability is lowered by diminishing the local supply of oxygen, by admitting certain toxic substances to the blood, and by repeated simulation. The conditions of health for a working muscle, therefore, are "a full supply of proper food and oxygen, unimpeded and sufficient drainage, and rest at due intervals" (Hartwell). Work under these conditions improves the nutrition and competence of the muscle, and increases its size. The effect of muscular contractions on parts outside the muscle are dilatation, diminished pressure and increased flow in neighbouring arteries, increased local venous flow of higher temperature and bearing more waste, increase in the force and frequency of the heart beats and in the number and amplitude of the respiratory movements, producing increased elimination of carbonic acid and water. The secondary vaso-motor changes and variations of pressure are very important. If many muscles are active, the cutaneous vessels become dilated, increasing the activity of the sweat glands and cooling the blood, and the abdominal and cerebral areas are drained of stagnant blood. The action of the liver, kidneys, and intestines is also increased, purifying the blood of waste material.

Such are in a general way the effects of exercise within physiological limits, but the effects will vary enormously with the amount of exercise in a given individual; for instance, cardiac action is diminished by some forms of massage and passive movements, stimulated by active exercise, and crippled or overwhelmed by too severe or too persistent exercise. The same amount of exercise may produce widely different effects in different persons, according to the health, previous training, and idiosyncrasy of the individual. Other important modifying effects are the freedom of action presented by the attitude and dress during exercise, the mental condition, the length of time after a meal, and previous exertion. It is necessary to distinguish between the immediate and remote effects of a given dose; for example, the urine may be diminished at first after active exercise, owing to increased perspiration; after a few hours it will be increased. One must also differentiate between transient and lasting, between incidental and paramount effects. Vigorous muscular exercise is, under most circumstances, unfavourable to intellectual activity at the time, but if judiciously used may vastly increase intellectual power, by toning up the system, improving cerebral nutrition, and increasing the range and variety of cerebral reactions. Especially do the effects of exercise vary, both in the short and the long run, with its relation to periods of rest and quiescence and the character of preceding exercise; unwisely practised, it may cause atrophy instead of growth, and will break down instead of building up the constitution.

Considered dynamically, a muscle is a machine for converting the potential energy of the nutritive elements in which it is bathed, and those which are stored up in its own structure, into heat and visible and tangible movement. The contractile power of human muscle varies with its sectional area, and is from 5 to 10 kilogrammes to the square centimetre. The work done by a muscle is measured by the prod-

uct of the weight raised multiplied by the height through which it is raised. An ordinary labourer at work does about $\frac{1}{8}$ grammetre to the gramme of muscle a second; taking his muscles to weigh 25 kilogrammes, his work during eight hours would equal 144,000 kilogrammetres. A man walking does work at about the same rate. A long-distance bicycle racer is calculated to do work at the rate of 1 grammetre to the gramme of muscle a second for eight hours. The work of a short-distance runner is estimated to amount to about 2 grammetres to the gramme a second. Marey estimates the work done in walking and running on a level at between 10 and 20 kilogrammetres to the step.

The energy of the assimilated food and respired oxygen becomes active, not only as work, but also as heat; the former represents about one fifth, the latter about four fifths of the energy developed. Not the muscles alone, but all the tissues, including the blood, are a vast laboratory for converting the energy of chemical affinity into heat, and this transformation must go on to keep up the temperature of the body, whether the latter be at rest or at work. "The tissue changes of a human body weighing 140 pounds are estimated to involve the transformation of more than a ton of material in a year" (Hartwell). There is a great deal of necessary and almost unnoticed muscular work constantly going on—namely, the cardiac contractions, the movements of respiration, and the adjustments of the muscular coats of the vessels and viscera, so that the mechanical work done by a man at hard labour for eight hours is equivalent to less than one seventh of the total energy developed in keeping up the heat and necessary vital movements for twenty-four hours. A man who does no voluntary work for twenty-four hours spends about five sevenths as much energy as a man who also does a day's work of eight hours during that time. The expenditure of energy is relatively large in the resting state, but active use of the skeletal muscles not only greatly multiplies the reactions in the nerve-centres, but aids nutrition and increases muscular, mental, and vital tonus.

The muscular groups are so disposed and related that scarcely a movement is made that does not involve many muscles and many groups. Flexors pull against extensors, adductors against abductors, whichever the direction of the movement. When a stick is grasped by contracting the flexors of the fingers, the extensors contract simultaneously and in proportion, to balance the movement and effect a secure equilibrium, as sailors shift the yards of a ship, some pulling them forward by one set of ropes, while others pull back by the opposing set, but allow them to slowly pay out. In the example of grasping, the action will be assisted by the small muscles of the hand, and the wrist will be steadied both antero-posteriorly and laterally, in order to keep the hand in the most favourable position. In lead palsy the extensors only of the wrist are paralyzed, but the flexors are of little or no use, since the wrist drops and the flexors act but feebly in that position. This interdependence of muscular action does not stop here, but in proportion as effort is put forth or some special attitude is required, nearly all the skeletal muscles may be brought into play in performing the simplest acts, each set of muscles being braced to give a fixed point for the action of the next set. If a nut is to be crushed between the thumb and forefinger, the muscles which approximate these digits, their antagonists and modifiers, are all actively engaged, also the muscles steadying or fixing the wrist, elbow, shoulder, and trunk, and even the muscles of the limbs supporting the trunk, and as the supreme effort is made respiration is checked from fixation of the chest, the jaw is set, and the face, neck, and back are rigid. A boxer hits from his legs and trunk. In nearly all effort the chest is constricted or fixed to give a firm basis for the action of the extremities, which is one reason why active arm movements are not those best calculated to develop chest expansion.

These important facts must be remembered in prescribing exercises, since the secondary or remote muscular contractions may be therapeutically the most significant for the case in hand. The poise and habitual or dominant attitudes of the body largely modify the effect of muscular activity. An exercise may be taken in one attitude with great benefit, and in another with the opposite effect. The bent back of the bicyclist, causing him to ride with a contracted chest, when the exercise demands increased ventilation of the lungs, is a case in point. When effort, faulty attitude, or constricting clothing hamper free chest and abdominal action, the best results can not be attained. Even when due care is taken, certain exercises predispose to certain deformities from the excessive development of certain parts or the tendency to produce certain attitudes. The rounded back and shoulders of heavy porters, boxers, and gymnasts are examples; the hypertrophied right arm of a blacksmith or the leg of a turner may interfere with that delicate adjustment of the poise which is necessary to a symmetrical equilibrium. Fencing with effacement of the body—that is, presenting the side of the body in order to restrict the surface exposed to attack—produces lateral curvature, with the concavity toward the sword arm (Lagrange). Other deformities, like the flat feet and knock-knees of bakers and waiters, are due to the pressure of superincumbent weight; others, like housemaid's knee, to the traumatism of particular occupations. An indolent or sedentary life has also its peculiar deformities of relaxation and imperfect metabolism.

When a muscle is stimulated too often or too violently it becomes less able to respond, or, as we say, fatigued, and this is accompanied by a sensation of discomfort, which impels us to rest and usually prevents that utter powerlessness which supervenes in a separated muscle after excessive artificial stimulation. The sensation of fatigue is partly due to the effect on the nerve-centres of increased quantities of carbonic acid and other decomposition prod-

ucts in the blood, but also to the stress of the violent activity of the centres themselves. Besides fatigue, which may go on to exhaustion and even collapse, the principal toxic effect of exercise are breathlessness and stiffness. Breathlessness is caused by the reflex efforts of the system to rid itself through increased respiration of the excess of carbonic acid developed during exercise. It is proportionate to the amount of work done in a given time, and hence supervenes very quickly in wrestling, when the whole body is violently engaged, and more quickly after running or climbing than in arm exercises. Exercises of skill do not so readily produce breathlessness, but are followed by a kind of fatigue resembling mental fatigue, since the principal stress falls upon the nerve-centres. How largely the mental factor enters into these phenomena is illustrated by the greater breathlessness attending and fatigue following a duel than a fencing bout of the same duration. Stiffness shows itself many hours after the exercise, and is due partly to traumatism in and near the active muscles, and partly to the accumulation of the decomposition products of reserve materials (Lagrange). Its distribution will show where the main brunt of the exercise fell, or where the muscles were least braced by training. Besides these nearer effects, there are the chronic toxic effects of exercise too intensely pursued, too frequently repeated without due intervals of rest, or taken improperly. Exercise under such conditions produces atrophy instead of development, and breaks down instead of building up the system, as is often seen in the overtraining of athletes and others, especially when severe exercise is associated with mental worry and other unhygienic conditions.

It has recently been reported that fifty-seven cases of insanity, of which 70 per cent. were clearly due to the strain of overwork, occurred in six years among silk-mill employees in a New Jersey manufacturing town. This is but an instance of conditions widely prevailing in modern industrial communities, and indicates that large numbers of the population are on the edge of a breakdown from the excessive strain of physical toil and mental stress.

Nothing modifies fatigue more than the training of the individual. When a movement or series of movements is often practised, not only do the muscles used develop in strength, but the nervous mechanisms, which bring about their co-operative activity, work more smoothly, economically, and promptly. The same work is done with less waste and less effort, because of a nicer adaptation and balance in association. Finally the action, as running, swimming, or playing on a musical instrument, becomes so well learned that paths of reflex association are formed, and it becomes largely reflex in character, requiring only the occasional intervention of the will to adapt it to the purposes of the individual.

Training also prevents or corrects the overstocking of reserve materials, whose decomposition during exercise is said to be the main cause of stiffness. A trained and practised oarsman can row for hours without subsequent stiffness, and with but a fraction of the expenditure of mental and muscular force that a learner would use, but if unused to fencing, fifteen minutes of this exercise would be followed by stiffness and fatigue. Mental worry, sleeplessness, or anything subjecting the system to unusual strain will powerfully predispose to the toxic effects of exercise. The element of training should be carefully regarded in the prescription of exercise. One exercise should lead up to and prepare for the next in a series, and the normal effect of an exercise when once acquired should not be confounded with the effect of learning it without special preparation. Cycling, for example, at moderate speeds and on a good road, is light exercise, but learning to ride a wheel, as ordinarily practised, is severe exercise for a strong man.

Besides the exhaustion due to using up the stores of decomposable material, to the stress of violent or often repeated reactions, and to auto-intoxication, there is a kind of collapse due to the imperfect elimination of heat, commonly called sunstroke. This occurs only in those engaged in laborious occupations in a heated atmosphere—and only in certain climates—whether exposed to the sun's rays or not.

In accordance with the law of economy, the parts most used within physiological limits will inevitably become larger, firmer, and more competent than neglected parts, and habits, occupations, and training become solidly registered in the structure of the body. Parts in intimate relation with specially exercised muscles share in the improved local nutrition and drainage, and even the bones participate to such a degree in the development of the muscles whose attachments they bear that it is often possible, from the size and structure of the bones alone, to form a fair idea regarding the nature of the muscular life of their former possessor. Further, as the circulation, ventilation, and purification of the blood are stimulated by vigorous, well-distributed exercise, all the tissues participate in the benefit of increased metabolism and improved nutrition; the skin becomes clearer and pinker, the eye brighter, the carriage more graceful, the bearing more buoyant, the mind more cheerful, confident, and active. The constant repetition of restricted exercises of strength and endurance, however, will result in great muscular development, with little physical or mental flexibility; in other words, the narrow though powerful muscular reactions will be reflected in a clumsy and restricted mentality, as when some forms of athletics and laborious occupations are too exclusively practised.

Habits of indolence and a sedentary life will as inevitably be reflected in weak and flabby muscles, soft or brittle bones, deficient respiration, feeble circulation, eccentric or sluggish mentality, deficient reactive powers, and languid or inefficient nutritive processes, with a meagre or corpulent figure, and stiff or flabby and ungraceful carriage.

In default of considerable habitual muscular

activity, life progresses on a distinctly lower plane, since there is lacking an element essential to the proper stimulation, development, and balancing of the vital activities, and to the establishment and maintenance of a vigorous and responsive vital tonus. This is equally true of the involuntary muscular system which is dependent for its tone and vigour upon the variety and intensity of its habitual, proper experiences, as well as upon the habitual movements of the skeletal muscles. In the same way that deprivation of movement leads to degeneration of the voluntary muscles, so the lack of the direct stimulation of changes in the surrounding medium leads to imperfect adjustment and feeble reactions in the vascular and visceral apparatus. The natural desire to avoid hardship and to shield the tender and delicate leads to the debility or atrophy of the natural mechanisms best suited for their automatic and sure protection. The risk of systematic exposure is trivial as compared with the risk of overcaution. There is no adequate protection against cold, dampness, draughts, or toxic influences for child or adult, sick or well, except the protection of a responsive and well-braced vascular and respiratory apparatus.

Nearly one half the weight of a well-developed individual is contributed by the five hundred voluntary muscles of the body, and the vital economy is arranged with reference to a large dependence upon muscular activity for its proper functioning. The larger muscles act like so many more hearts, kneading and compressing the vessels and organs in their vicinity, assisting the blood current, their own drainage, and that of neighbouring structures. In the absence of considerable vigorous use of the larger muscles, one must be content to go through life withered in the essential elements of vitality and steeped in one's own effete and poisonous waste. Muscular activity "is one of the chief agents in promoting wholesome tissue changes in all the bodily organs, and in determining the normal growth and development of the organism as a whole" (Hartwell).

Under existing conditions of life, our habitual work, occupations, and diversions will usually exert a paramount influence in shaping muscular activity, and hence in determining bodily growth and development, and it is therefore of the utmost importance that these occupations should be chosen and regulated from the start with some appreciation of their physiological effects.

Due account should be taken of the natural order of development of the different organs and systems, and especially of the nervous system.

The order of development of associated purposive movements is such that the more fundamental and least differentiated, in general those nearest the axis of the body, develop first, for the reason that the correlated parts of the nervous system are first perfected. The intercostal muscles, diaphragm, abdominal muscles, and those of the pelvic floor with their corresponding nerve-centres, become functionally active very early. Afterward co-ordinated control of the neck and trunk; then of the leg and foot, arm and hand, and much later the finer movements of the fingers, tongue, lips, and larynx are perfected. The slight elevation of the ball of the foot to allow the passive leg to swing forward in walking is the last movement of the lower extremity to be acquired, and often the first to be impaired by disease. Movements of the hands and fingers and rotation of the forearm are the last movements acquired in the upper extremity. Movements requiring the co-operation of the large muscles of the trunk and limbs in balancing, like standing and walking, are acquired later still.

The question of the effect and importance of exercise confronts the physician on the very threshold of life, and it is certain that the failure to understand the needs of infants in this regard is productive of untold mischief.

Babies develop and co-ordinate their powers most readily by reacting, unhampered, to the stimuli which reach them. They exercise themselves, unless hindered by constricting bands, burdensome wrappings, and officious attentions. It is well to keep the feet bare, to ventilate the skin, and allow free play to all the movements, by frequently removing all clothing in a mild atmosphere.

The physical peculiarities of the infant and child afford valuable hints in the management of exercise. Variety and rapidity of movement are instinctive, and while the movements of a healthy child would, if closely imitated, tire out an athlete in a few hours, no one thing is long pursued. The child's mind and body are ill adapted to concentration and persistence, and exercises of strength and endurance are badly borne; a child that will run about and play actively all day will be exhausted by a walk of moderate length. The child is practising the scales of muscular experience, in order later to select the chords and arrange the harmony. It is noticeable that this wealth of neuromuscular experience not only gives the child physical grace and vigour, but, in proportion as it has been varied and natural, the mind will be clear, poised, and well balanced. The life of young children should be largely interspersed with such open-air plays and sports as attract them and involve the healthy and harmonious action and reaction of the more fundamental muscular groups, by rapid changes of movement and balancing exercises. Effort, concentration, routine, and stiff or fixed attitudes should be avoided. It is said that a certain highway leading out of London was noted for its pre-eminence in breaking down draught horses. It was found on investigation that it was the most level of all; as the same muscles were used in the same manner until worn out, the work was physiologically more severe than that on the more uneven roads, which gave a greater variety of muscular action, though they may have called for the expenditure of more force. Childhood abhors system and concentration, and these necessary ingredients will be better acquired later, when physical and psychical development afford a rational basis. Children as well as adults suffer from the confined, formal, limited and strenuous

conditions of city life, and especially from the meagreness of muscular experience and vascular and visceral reactions ordinarily evoked. The hard and mostly level surfaces afford little diversity of muscular action, and the wholesome exercise of climbing, owing to the levelling of roads and the introduction of elevators, seems in danger of becoming a lost art. The child of the well-to-do, when not confined to a few rooms, rides out with an attendant or walks in a procession. The poor child is shut in the house or plays about the sidewalk. It is stated that there is but a single open-air playground in New York city in connection with a public school. Schools and houses are overheated and badly ventilated, and this, with the undue anxiety of parents to prevent exposure or chilling, results in debility of the adjustive powers of the involuntary muscles and their centres, which must become vigorous through varied use if at all. While we are endeavouring to develop the mental powers through formal training of the eye, ear, and memory, we are surely raising barriers to mental growth by neglecting the neuromuscular system. "The detective exercise of any group of muscles during the growth period of any particular centre . . . will result in the dwarfing of that centre, and a corresponding hiatus or mental weakness must exist in the whole mental fabric" (Hartwell).

Exercise must be taken under proper conditions and in proper amounts, however, in order to produce good results. Children of the artisan class get more muscular exercise than those of the so-called favoured classes, but English statistics of nearly eight thousand youths of each class between the ages of ten and thirty show three inches less mean height for the artisan class. This is partly due, no doubt, to deficient nourishment and faulty hygiene, but probably also to toil or excess of exercise.

It is a distinct disadvantage for a girl to grow up without the discipline and muscular training of housework, and it is to be regretted that the value of this home gymnasium is not better appreciated. This should be supplemented by a large variety of out-of-door sports and pastimes. Walking, cycling, climbing, gardening, swimming, tennis, riding, and rowing—vigorous exercises involving mainly the fundamental movements, and largely stimulating respiration, circulation, and nutrition—should be enjoyed as a part of daily life, not exceptionally practised. Dancing is both pleasant and beneficial if practised under hygienic conditions, but, like other exercises, may be distinctly detrimental under unhygienic conditions. Seclusion, intense emotionalism, and frivolity are in the long run drags on symmetrical development, and there are other unfavourable tendencies in modern girl life. Piano practice illustrates some of them, and its unfortunate effects are so common as to call for special mention. Piano training certainly has its value, but as usually practised is useless and even harmful as exercise. The movements are of the accessory kind, which are valueless for the general effects of exercise, but count for much in local and general strain and fatigue on account of their monotony, the fixed attitude of the body and mind, and the strain on the eyes and attention. It is, moreover, often added to overstudy at school at the period of development which makes special and urgent demands of its own upon the strength. What wonder that backache, headache, lassitude, and faulty attitudes often result, and that lateral curvature of the spine so frequently occurs in those who are obliged to practise the piano in hours that should be devoted to rest and recreation? If the patient is a schoolgirl there is no need to ask the question. Does she practise the piano, but only How much? The suggestion is offered that if one quarter the time that is unintelligently devoted to acquiring a smattering of piano technique were devoted to rational voice culture, there would be no loss to æsthetics, and the gain to maiden physique would be inestimable.

Lateral curvature is only one of the many expressions of physical degeneracy consequent upon the strains to which an overworked organism is subjected at the suggestion or with the connivance of unwise parents; others are flat feet, weak ankles, flat and narrow chest and round shoulders, slovenly, because tired, postures, poor circulation and nutrition, dyspepsia, later menstrual disorders, relative or absolute sterility, chronic backache, headache, neuralgias, nervousness, and in cases not a few a profound and permanent invalidism or inadequacy to the ordinary demands of life. The strenuous and short-sighted ambitions of modern life press with peculiar severity on women, and through them, yet not alone through them, is affecting the vitality and symmetry of coming generations.

Habituation to considerable diversified exercise from early years can not fail to invigorate all the functions, and to better equip woman for the serious demands laid upon her. A striking example of the effect of continuous muscular training upon pregnancy was given some years ago by Dr. Sarah E. Post, who published the experiences of several female circus riders and trapeze performers who had been rigidly trained from childhood. The riders were not only able to perform their feats, involving running, jumping, vaulting, and other severe exercises, through the menstrual period, though the flow was sometimes checked during the performance, but in several instances the regular work was continued up to the eighth month of pregnancy without apparent evil result to mother or child, labour coming on naturally at the usual time. These observations agree with similar facts observed in the life of savages. While women who are not used to exercise often miscarry on slight overexertion, if these same women were habituated even to housework and walking this danger would be immensely diminished. Binding and constricting clothing, and even its weight alone, which is sometimes prodigious, often offers a serious impediment to exercise, and not seldom entirely neutralizes any beneficial effect. Even the small but important matter of too high heels may disturb the delicate equilibrium of opposing muscles at the knee, hip,

and back, and render proper exercise impossible; or a shoe too short or too narrow may operate as a continued check on harmonious action. When women understand that exercise regularly taken, under hygienic conditions, heightens the colour, brightens the eye, develops in due proportion the curves of the bust and waist, and gives grace, animation, and charm, they will not neglect so potent a beautifier.

Men are less hampered by dress, custom, opportunity, and inclination in the exercise of the body, but even with them exercise is too often neglected or misapplied. For millions exercise comes mainly as an accompaniment of formal pursuits, and is so limited in range or so excessive in amount as often to be harmful. The younger boys find a wholesome diversity of action in doing chores, in sports and pastimes, and in the use of gardeners' and carpenters' tools. Competitive athletics, too, has done much to cultivate a wholesome respect for the bodily powers, though often carried to harmful excess in individual cases. Habituation and training play an exceedingly important rôle. The city-bred youth with small opportunities for exercise and debilitated by his unhygienic and limited mode of life, and perhaps by inheritance, is not only weak in his neuromuscular apparatus, but his vascular system and bony and connective-tissue framework share in the general debility. Now, when such a lad, with small previous training, goes into a foot race or boat race or attempts unaccustomed feats on the field or in the gymnasium, his tissues are often inadequate to the sudden demand; he sprains an ankle, ruptures a muscle, or breaks a bone; or if the test be one of endurance, he faints, and perhaps permanently cripples his heart. Dr. Seaver, of Yale, recently related two cases where the heart was permanently disabled from the game of "hare and hounds," usually esteemed innocent, and therefore indulged in by the untrained. Dr. Le Gardre has seen two cases of acute dilatation of the right heart after sprinting and football, and remarks that the thorax is less developed than the heart between the ages of fourteen and sixteen, and therefore restricts heart action unduly. The case of a Norwegian physician is reported who dropped dead on returning from a *ski race.* Twenty-seven deaths from football were reported in England in 1893 and eight in the United States. But, in spite of some serious dangers and innumerable minor accidents, the present interest in open-air athletics is a strong influence for good. They make recreative exercise interesting for the masses; they tend to develop courage, endurance, and temperance. While individuals may and do break down under the strain of athletics pursued not wisely but too well, much of the enthusiasm is distributed among the spectators, and even among those who hear or read of the contest, and awakens dormant energy and a desire to feel the glow of muscles energetically used. It is not improbable that the spectators of an athletic contest receive considerable benefit of a kind similar to that produced by actual exercise merely from being stirred by the sights and sounds of the competition, and a feeling of invigoration is often carried away.

Whatever good may be accomplished by formal methods, it seems probable that much more fundamental effects for good or evil are ordinarily produced by the exercise involved in every-day life, and in the activities of voluntary pursuits and recreations. Exercise, to produce its best and most radical effects, must be made interesting, and must be pursued in the open air. More will ordinarily be accomplished for general invigoration by telling a man how to spend his spare hours and holidays pleasantly than by telling him which set of muscles or organs are weakened and most need cultivation. The hygienic value, as well as diversion, of gardening, rambles in the country or in the woods with fishing rod, gun, or camera, have not been sufficiently appreciated in this country. Walking over an uneven country and climbing are among the best all-round exercises known, and if any athlete will try them he will discover the next day groups of muscles whose existence he had not previously suspected. We lack as a nation military drill, which is a potent though imperfect muscular training for large bodies of men in Europe, and with reference to which gymnastics has been largely moulded, and if we would supplement our routine activities, which are usually as narrow as they are intense, by the persistent exploitation of what near-by Nature has to offer, we could well afford to dispense with it. In order to be made attractive, exercise must usually be the incidental accompaniment of the pursuit of some fancy or the indulgence of some taste, rather than dully hammered out from a sense of duty. Gardening, hunting, fishing, climbing, rambling for some useful, artistic, or scientific purpose, fulfil this requirement, are diversified, develop mainly the more fundamental movements of the body and operations of the mind, which is occupied just enough to hold the attention in new channels. For city men it breaks up the shuttlecock vibration between a den for sleep and a den for work, and opens up new vistas, with ruddier blood and stouter fibre. The gymnasium offers nothing so good as rambling, running, jumping, climbing, swimming, tennis, cycling, riding, or rowing in the open air, which are within the reach of thousands who never saw and never will see a gymnasium.

For old people exercise should be moderate, regular, and not too prolonged. Neither speed, skill, nor endurance should be greatly taxed.

Walking, driving, gardening, climbing moderate slopes, are suitable; and cold bathing to keep the vascular system vigorous should not be neglected. Old people, especially if not habituated to exercise, and convalescents, should proceed with caution in exercises which make considerable demands upon the heart. Two deaths from heart failure due to bicycle riding have recently been reported by a French physician. The first was in an apparently healthy man of sixty; the other in a young man convalescent from typhoid fever.

Therapeutics.—Exercise is not a remedy which in some mysterious way may prove beneficial in disordered conditions of the system, still less a specific in any given disease, but it may be made the means of producing gentle or powerful effects of a definite kind, which vary with its form, intensity, duration, time of application, method of administration, and the condition of the patient. The problem presented to the physician in a given case is not merely the prescription of exercise, but rather such proportioning and contrasting of the muscular activity to periods of rest that the total result shall be beneficial; here, as always, the patient is to be treated rather than the disease. Exercise employed systematically and with discrimination is of the highest value in the prevention of debility and disease, and also in the treatment of certain chronic affections. In many acute and some chronic diseases exercise is positively and actively injurious, and it is always liable to prove so when employed without due regard to its physiological effects. Though most of the useful effects of exercise can be obtained under skilled supervision with little or no apparatus, its practical importance is ignored in hospitals, but little recognised in asylums, and imperfectly appreciated in private practice. The neglect of exercise as a therapeutic resource is traceable to failure to appreciate the indications for its employment, and perhaps still more to lack of precision in its application. While its proper prescription is undoubtedly more difficult than that of drugs, no drug is capable of producing effects at all comparable, and the care and attention devoted to its intelligent application by physician and patient is well repaid. It is a practical point of the first importance that individuals differ enormously—according to constitution, temperament, training, and previous habits—as to the amount of exercise that will be required to produce a given result. While those who have been trained may require severe or laborious exercise to produce physiological effects, the writer has met with individuals free from disease in whom the gentlest passive movements, lasting the fraction of a minute, would produce decided subsequent stiffness and constitutional disturbance. As it is just these sensitive and undisciplined people who may be most benefited by properly adapted exercise, it is evident that the kind and amount required must not be gauged by any absolute standard, but by the reactive powers of the individual. Like some drugs, exercise may produce different and even opposite effects, according to the dosage and consequent intensity of action. Slow rhythmical passive movements are decidedly calming, while moderately active movements are stimulating to mental action. A careful distinction should be made between primary and remote effects. Exercise has also its synergists, antagonists, and incompatibles, its acute and chronic toxic effects, and their antidotes. The synergists of exercise are fresh air, a nourishing diet, sufficient rest, an unstrained and cheerful mind, and temperate and regular habits; moderate cold and possibly certain tonic drugs are a help to exercise. Exercise is antagonized by the opposites of the above-mentioned, and by toxic substances in the blood. Some interesting facts have recently been observed as to the effect of the use of tobacco in checking growth and the developing effect of exercise. From measurements of the 187 men of the class of 1891, Yale, Dr. J. W. Seaver found that the non-users of tobacco gained in weight during the college course 10·4 per cent. more than the regular users, and 6·6 per cent. more than the occasional users of tobacco. In height the non-users increased 24 per cent. more than the regular users and 12 per cent. more than the occasional users. In increase of chest girth the non-users had an advantage of 26·7 per cent. and 22 per cent., and in increase of lung capacity of 77·5 per cent. and 49 per cent. respectively. These facts in regard to the dwarfing effects of tobacco are corroborated by observations on the class of 1891, Amherst, made by Dr. Edward Hitchcock. He found that in weight the non-smokers increased during their course 24 per cent. more than the smokers; in increase in height they surpassed them 37 per cent.; in gain of chest girth, 42 per cent.; and in gain of lung capacity, 75 per cent. It is probable that alcohol and other poisons have similar effects.

Exercise of the skeletal muscles is contra-indicated in hæmorrhage, fever, inflammation, certain toxæmias, and serious injuries. Pain is an uncertain indication; if it result from inflammation or local injury, exercise is contra-indicated, otherwise not necessarily. In acute local inflammations exercise is very injurious, since it increases the local congestion. Severe or sudden exertion should not be permitted in cases of aneurysm, atheromatous arteries, cardiac vegetations, or extreme cardiac weakness, but systematic training may be beneficial in the latter condition. Severe exertion should also be avoided soon after eating and in states of great physical and mental fatigue. Nothing will break down the system more quickly than the combination of mental worry or strain with physical prostration, though gentle exercises are often of value in resting the brain by bringing new centres into play, and thus effecting a better distribution of cerebral activity. It is futile to add to the burden of individuals already overworked, and the proper remedy in such cases is the reduction or proper proportioning of their total work, better hygiene, and provision for adequate periods of rest, repose, and recreation, which are the efficient antidotes for the toxic effects of excessive exercise. Well-chosen exercise may often be made to minister to mental poise, and thus to restful effects. It has been pointed out that the individual patient usually needs not exercise or rest exclusively, but exercise and rest in the proper proportions and in the proper order. The beneficial effects of treatment may often be enhanced by placing the two in sharp contrast. Exercise produces a better impression on a background of rest, and rest on a background of exercise; and particular attention should be paid to securing variety of action by contrasting one set of exercises with others

involving different groups of muscles, or the same groups in a different manner. The level road may be the harder to travel in the long run. Neither its specific effect in any named disease, still less the piling up of enormous masses of muscle, is the therapeutic object of exercise, but the production of definite local or general physiological effects. Increased muscular power is usually an incidental result, but marked remedial effects are often produced with very moderate muscular development. The too dominant idea of "gymnastics" should not make us lose sight of the vast therapeutic importance of the nervous reactions associated with muscular movements, and of the systematic culture and training of the involuntary neuromuscular apparatus, which certainly depends in large degree on the activity of the skeletal muscles, but is often best elicited by massage, passive movements, hydrotherapy, and hygiene; all these involve exercise in a fundamental sense, and are of great therapeutic utility, even in febrile states, where exercise of the skeletal muscles is absolutely contra-indicated.

The professional and domestic occupations, recreations, and sports have been noticed in their relation to the hygiene of exercise, and it is desirable that these means, which are within the reach of such large numbers of people, should be more often utilized therapeutically. For this purpose it should be remembered that many exercises have a preponderating effect on certain organs.

"Rowing tells on the breathing organs; the work of dumb-bells, and of other exercises where muscles are moved without progression of the body, tells most on the muscles themselves; and long pedestrian feats, with climbing, tell on the nervous system. In cycling, as in running, it is the heart and circulation that first give demonstrative evidence of important change of action" (Richardson).

Housework, chores, gardening, walking, climbing, cycling, running, swimming, and many other sports give just the kind of exercise that is indicated in certain conditions, due regard being had to the physiological effects of varying dosage. Oertel has shown how the simple exercise of walking may be adapted to sufferers from cardiac debility by prescribing the distance and speed, and the number and length of the rests, on definite paths graduated according to their slope. His interesting and original work has not only given a new direction to the treatment of certain cardiac affections, but is destined to have an important influence in establishing accuracy in the prescription of exercise. Whoever has studied the map of the environs of Reichenhall, Bavaria, prepared by Oertel for the application of his method, will acquire a vivid idea of what precision of dosing in exercise means. In this map the different paths suitable for the work are marked in four different colours, to indicate those that are nearly level, those slightly sloping, moderately sloping, and steep, and figures are placed along each route to show the space that should be traversed in each quarter hour. The locality itself is prepared for its remedial use by placing benches for resting at suitable distances, and by marking on certain trees near the path circles, coloured to correspond with the map, to indicate the difficulty of that particular section. By systematic practice on the easier paths the heart and system are progressively trained and strengthened. Intelligent analysis may do the same work for cycling, horseback riding, and many other familiar exercises. In this way the dosage is practically reduced to a definite number of kilogrammetres in a given time, and a step has been taken in placing the prescription of exercise upon a scientific basis.

Recreations and sports have the inestimable advantages of being taken in the open air and being interesting to those who take them—two factors whose absence in any form of therapeutic exercise is with difficulty atoned for. Athletics, though sharing in these advantages, are not well adapted to most therapeutic purposes, on account of their excesses, indefinite dosage, and lack of variety, each contestant being a specialist in one or a few forms of exercise. There remain for consideration the formal exercises of drill of various kinds, gymnastics, Swedish exercises, including passive and mechanical movements, and massage, which is elsewhere treated of in this work.

As the primary purpose of military, fire, and other drills is not therapeutic, they are not well suited to the treatment of disease, though they share in the beneficial effects of systematic exercise. The manual of arms is not adapted to young children, being too formal and too strenuous; the writer has seen cases of lateral curvature, knock-knees, nervousness, and debility in young boys which had apparently been aggravated if not produced by military drill.

Modern gymnastics has been largely shaped with reference to military purposes, and, while gymnastic exercises, if well selected and proportioned, do promote muscular development and physical grace and vigour, they are easily carried to an extreme, and instances are not rare where they have broken down the constitution, instead of building it up. Feats of skill train the nerve-centres more than the muscles, and once the trick is acquired, their value as exercise is slight. Feats of strength often put an injurious strain upon the organism, with no corresponding benefit. The arm appears to be the object of all the exercises of modern gymnastics (Legrange): breasting and other movements which throw the suspension or support of the body upon the arms and shoulders give them unsuitable work, and result in disproportionate development of the muscles of the shoulder girdle, often associated with a rounded back, and little or no increased power of ventilation, since all such feats are performed with a chest fixed and constricted by muscular effort. The gymnastics of the modern gymnasium are in marked contrast with the athletic exercises of the Greeks, with whom the striving for physical perfection amounted to a passion. Their exercises were running, wrestling, boxing, fencing, and throwing the discus, taken in the open air, without apparatus, and

exercising the body throughout, and especially in the fundamental associated movements of the trunk and limbs. The defects of ordinary gymnastics have been felt by those interested in physical culture, and have been partly obviated by the introduction of free movements, like running, jumping, and wrestling, and partly by the use of resistance machines, usually constructions of levers, pulleys, and weights, designed to exercise special groups of muscles, as in the Sargent system of apparatus. These reward effort, however, with depressing monotony, are devoid of most of the beneficial general effects of exercise, and appear to the writer to lack the elements of a coherent system.

The old gymnastic idea, in the endeavour to accomplish certain feats and to pile up large masses of muscle, ignored the intimate co-operation between muscle and nerve, and the delicate balance between co-operating and modifying muscular groups necessary to build up a clear-sighted, well-balanced mind, in perfect and harmonious but largely unconscious mastery of the bodily movements. The wise teacher and physician have small interest in gymnastic feats, but direct muscular activity into those channels best suited to promote harmonious mental and bodily development and adjustment.

With the Swedish system of exercises, devised by Ling and elaborated by his pupils, totally different ground is reached. Peter Henrik Ling was a fencing master, who became interested in exercise as a stimulus to development and as a remedy from observing its beneficial effects on his own health. He never took a medical degree, but developed remedial exercises into a system, which remains to-day as the basis of the most valuable procedures in therapeutic kinesiology. He also devised systems of educational, military, and æsthetic exercises. These exercises are based on the physiological actions of the different muscle groups and their relations to each other, and consist in free voluntary movements executed by the patient in different positions and in a determined order. The remedial movements include, in addition, passive movements executed by a manipulator, and assistive and resistive movements, in which the operator opposes resistance to the movements of the patient, or *vice versa*. To these are added the various manipulations of massage.

The Swedish therapeutic exercises emphasize strongly the local effect of movements, and hence have been called localized movements, and are largely used for specific local purposes. They proceed from the simple to the complex, aiming to establish correct fundamental attitudes and relations, and to invigorate and develop deficient parts through exercises adapted to the particular condition and situation. The value of gentle and passive exercise in conditions of debility, and of the systematic progressive adaptation of the exercise to the strength of the patient, is recognised and practised.

The Swedish system avoids the abnormal development of special parts and the gratuitous feats of ordinary gymnastics, and produces normally acting viscera, a graceful carriage, and good muscular and mental control. One school of the Swedes, led by Zander, has in the last thirty years developed a system of mechanical movements, both active and passive, given by means of apparatus. In these the resistance and amount of motion can be graduated to the patient's needs, and the personal element of the operator is eliminated. Each system fulfils certain indications, and neither can wholly supplant the other. If the Swedish school had given us nothing more than passive movements in therapeutics, our debt would have been great. The extraordinary prominence in recent years of massage as a remedial agent, in so far as it is justified by results, rests largely on the employment with it of passive movements. These enable the patient to obtain many of the benefits of exercise without effort and without undue fatigue, and can be employed in thousands of cases when active exercises are contra-indicated or impracticable. Through passive exercises may be obtained the local effects of exercise on the circulation, easing of cardiac action or its gentle stimulation, mental discipline, or mental sedation, as in the soothing effects of rocking or swaying movements on infants; in a word, the more harmonious distribution of nervous and vascular activity.

It is well to remember Ling's adage that every movement properly performed is a respiratory exercise, and it is probable that respiratory development may be best attained through climbing, running, and similar exercises by those who are strong enough and energetic enough to take them. Those who most need them, however, are neither strong nor energetic, and it is often impossible to get patients to practise the purely respiratory exercises with sufficient care and persistence. In such cases, where more thorough pulmonary ventilation and respiratory power are required, passive respiratory movements manually or mechanically given, often serve a useful purpose.

There is no more promising field for the therapeutic application of exercise than in the treatment of the insane and mentally unbalanced and defective. The elder Seguin has shown that the idiotic brain could be most effectively reached and developed through neuromuscular training, especially of the hand, and the value of manual employments, industrial training, and social life have been to some extent recognised in provision for the epileptic, idiotic, insane, and criminal. The striking and oft-quoted results obtained by Dr. Wey in the physical training of vicious and stupid criminals at the Elmira Reformatory by means of improved diet and systematic bathing, massage, drill, and gymnastics, mark an era in the treatment of the defective classes. A large proportion of previously incorrigibly dull and vicious individuals submitted to a few months of this treatment improved remarkably in physical and mental condition. It is safe to say that better provision will be made in future in our public institutions for the proper application of exercise in its various forms of

manual training, sports, drill, gymnastics, and special exercises.

As exercise is a fundamental factor in the development and culture of the mind, it can be used to modify mental states, and has most important general and special applications in many nervous diseases. The repetition of rather gentle monotonous movements, especially of the automatic or passive kind, tends to allay mental excitement and nervous irritability. If the excitement is of the active insistent type, more vigorous exercise of longer duration to the point of fatigue may be beneficial, but should be semi-automatic, like walking, cycling, or rowing. These principles find a useful application in the treatment of insomnia. If the patient is dull and apathetic, with sluggish circulation and nutrition, exercises, involving quickness and skill—that is, a more lively mental co-operation, like fencing, tennis, or boxing, should be used. In other cases the brain may need to be progressively trained through manual employments. The finer and more delicately adjusted the movements the less their value as muscular exercise, and the more the nerve-centres are called into play. Writing, sewing, knitting, playing on instruments, and in general the use of the hands mainly are valuable as mental training, but lack the beneficial general effects of vigorous exercise of the more fundamental groups. From its action as a cerebral sedative or tonic, exercise may be used as a means of influencing certain definite areas in the centres, in order to soothe, to stimulate, or to distribute and proportion mental action; and certain exercises may be abstained from to deprive certain areas of stimulation. We know no drug that acts mainly on the arm centres or mainly on the leg centres, but we can with certainty bring either of these centres into action by prescribing indicated exercises. In an important group of neuroses due to the excessive repetition of certain fine movements, usually of the accessory kind, involving accurate co-ordination, such as writer's, telegrapher's, and piano-player's cramp, and similar troubles, characterized by local pain and incoordination, usually associated with extreme mental anxiety, the hurtful practice should be stopped and massage and more general exercises involving more fundamental groups substituted. In another class of cases—the bedfast neurasthenics—the nutrition must first be built up by seclusion and systematic feeding, and the neuromuscular system, both voluntary and involuntary, aroused and strengthened by bathing, massage, and passive movements. Patients that would be injured at first by attempts at active movements will thrive on gentle passive movements of the arms and legs, and will soon be actively co-operating. When sufficiently advanced they can be taught to walk, and before they can do much at this they can take with great benefit some forms of passive mechanical movements, given after the Swedish system with power machinery, and which cause them to execute walking movements, respiratory movements, and trunk flexions, while reclining, and with a minimum of effort and fatigue. Neurasthenics less severely affected can take such movements from the start, and they are indicated where the effects of exercise in equalizing the circulation and nervous activity, developing respiratory capacity and the supply of oxygen, increasing peristaltic and hepatic action, and nutrition, are desired for patients who are physically too delicate or who have too little energy or persistence to be able to get much benefit from exercise where vigorous volitional co-operation is involved. When the latter can be successfully prescribed the patient is well on the way to recovery.

Exercises of endurance, like cycling, rowing, and running, pushed to the point of considerable fatigue, are the most effective aids to continence, since the procreative impulse is the expression of a surplus of energy, and is abated if enough energy is regularly used up through muscular work.

As the larger number of functional disorders of the digestive system, such as dyspepsia and constipation, are the result either of the habitual neglect of muscular exercise or else of exercise taken under conditions of hurry, nervous tension, or fatigue, it is clear that the regulation of exercise and habits of life must be urgently indicated. In conditions of atony the patient must be trained to a variety of exercises, especially those involving the waist, abdomen, and trunk, among which the more active ones may be gradually introduced. In the cases due to debility from nerve tire, exercises requiring much skill should not be chosen, since these involve increased demands on the higher nerve-centres. As there is usually sluggishness of the abdominal circulation, those exercises should be selected which will act on the abdominal organs through the muscles of the waist and trunk and upon respiration. Among the best of these is riding, which, moreover, affords just enough variety of scene and interest in the control of the horse to turn the current of an incessantly active brain into new and more restful channels. Riding may be as accurately dosed as walking, and may range from very gentle to exceedingly severe exercise, according to the gait, training, and disposition of the horse, the muscular development, temperament, and expertness of the rider, and the character of the ride. Changing from one mount to another also gives more variety of exercise than always riding the same horse. Abdominal massage is sometimes useful in constipation, as are also the arm, leg, and trunk movements of the Swedes or of the gymnasium, and walking, running, leaping, tennis, and other sports have their uses. Whatever form of exercise is used, absolute regularity in attending to the calls of Nature must be observed.

Disorders of nutrition are powerfully affected by exercise, through the voluntary and involuntary muscles as well as through the nerve-centres. Respiratory exercises and exercises stimulating respiration and circulation are beneficial in anæmia, as are also the scientific application of massage and cold water to promote tissue interchange. By quickening

oxygenation, the circulation, and the nutritive processes, moderate systematic exercise causes thin and poorly nourished people to gain in weight as well as in vigour.

In most wasting and febrile diseases, toxæmias and inflammations, the strength of the patient is needed to combat the circulating poison, heal the local lesions, and keep the vital processes going, and for these reasons as well as on account of cardiac debility muscular exercise is contra-indicated, in some instances even during convalescence. Heart failure after diphtheria from changing from the recumbent to the sitting posture, and serious and even fatal relapse following too early sitting up after typhoid fever, are notable instances in point. Exercise of the unstriped muscles by friction and bathing may, notwithstanding, be extremely useful. It is noteworthy that under the supporting treatment afforded by cold bathing with friction much greater liberty is allowable. Not only do the patients bear well the lifting into and out of the tub, but some eminent physicians do not hesitate to let their typhoid patients sit up to adjust compresses to the body, to step into the tub, and even to walk to it with some assistance.

Exercise in the open air is of the greatest utility in the prophylaxis of phthisis. After the disease is developed exercise must be used with more caution, and in such a way as not to put great demands upon the vital powers of the patient. Moderate exercise out of doors and gentle respiratory exercises may be made beneficial, especially if directed to their gentle tonic effect and toward the better aëration of the pulmonary tissue.

There is a large class, especially among women, who habitually neglect exercise and lay up large amounts of reserve material in the shape of fat, which becomes burdensome by its bulk, and injurious by impeding the action of the organs in whose substance or vicinity it has been deposited. These people are not always large eaters, but having accumulated a physiological surplus, they have never been able to oxidize it. Exercises of endurance and respiratory exercises are well adapted to aid in burning up this surplus, and to improve the health. It may, in addition, be necessary to reduce the ingested fluids and fat-forming foods.

For those who habitually ingest too much rich and nitrogenous food and take too little exercise, whether suffering from typical gout or not, the systematic use of the muscles, together with a less hearty diet, is of the greatest value. It should be remembered, however, that when gout is developed, severe or unaccustomed exercise may precipitate an attack; systematically and judiciously employed in the intervals, exercise will tend to ameliorate the condition and prevent the recurrence of attacks. In diabetes, another disorder of imperfect metabolism, it has not been sufficiently appreciated that the surplus of sugar may be largely oxidized through carefully prescribed exercise. Walking is the most convenient form, and the amount should be graduated according to the patient's capacity and training. The aversion of the diabetic to exertion may be overcome by allowing limited amounts of bread as a reward for each mile walked. Those who have tried this plan find a decided advantage over a stricter diet and insufficient exercise.

The relation of exercise to the treatment of cardiac and circulatory affections has entered on a new phase since Oertel's original work. The dominant idea had been hitherto to relieve a weak or damaged heart of strain by avoiding exercise. Oertel teaches that the work of the staggering or flagging heart may be cut down by reducing the amount of ingested fluids, and the heart trained and strengthened by graduated daily exercise in walking on level and sloping paths. The results reported confirm the value of the method, and it is hardly too much to say that by accurately dosing and systematically applying this common exercise to meet the need of individual patients he has not only given the profession a valuable remedy, but a new point of view in the treatment of these serious affections. Oertel's cases are largely those of cardiac debility from imperfect nutrition of the heart and system, evidenced by fatty deposits in or about the heart, and not rarely elsewhere. This condition is usually the result of a too inactive muscular life, and in Germany is usually associated with the ingestion of large quantities of beer, so that the ill-nourished heart has an increased amount of fluid to pump. In such cases a large reduction of ingested fluids is a necessity while attempting to invigorate the heart by graduated and divided doses, at first small, of walking and climbing exercise. Where valvular disease, with or without dilatation, presents similar indications, a similar course may be followed, but such prescriptions must be made with accurate discrimination and analysis of the actual state and needs of the economy.

In the puzzling affection known as Basedow's disease, or exophthalmic goître, the therapeutics of which have been unsatisfactory, it has recently been found that systematic passive respiratory exercise is of great value. The cardiac and mental symptoms and nutrition improve with increased chest expansion under its use, which was first recommended by Dr. Louise Fiske Bryson, after the discovery of the markedly diminished chest expansion in these cases.

Though exercise occupies an important place in the treatment of certain deformities and locomotor disturbances, it must be noted that a vast amount of harm has been done by failure to appreciate the exact indications for its application.

In all cases where the spine or joints are the seat of tubercular or other inflammation the proper and necessary treatment is enforced rest, local or general or both, and not exercise. Modern improvements in orthopædic practice have made it possible to reserve recumbency for the acuter stages of joint disease, and by giving adequate protection by proper apparatus to enable the patient to be moved, and

even to go about during the longer part of the treatment. This has the obvious advantages of being less irksome and giving the patient the benefit of considerable open-air life, and nothing after local protection is of greater importance than large supplies of pure air continuously furnished. In a word, the back or hip is put to bed in the apparatus, while the patient goes about in order to get fresh air, but not in order to exercise; for even if certain muscles could be exercised without directly affecting the inflamed joint, the increased force of the blood current from the accelerated heart action would be deleterious to acutely inflamed tissues. The writer has seen a case of tubercular inflammation of the hip joint where the boy had practised bicycle riding, on his physician's advice, in order to overcome the stiffness due to reflex muscular spasm; and he has repeatedly seen cases of Pott's disease of the spine where the indication for enforced rest had been so far observed as to apply some form of apparatus, and yet the children were allowed to jump and run, and even indulge in cricket and football. Such practice rests on ignorance of the fundamental indications presented, and should be unknown. After all inflammation has subsided and the disease is cured, the formerly diseased but now weak and vulnerable joint is gradually permitted to resume its activity at a prescribed rate and in a prescribed order. The application of exercise in joint affections has been too largely dominated by the groundless fear that joint stiffness would result from quiescence. The best authorities are now agreed that stiffness after joint disease is proportionate to the extent and intensity of the inflammatory process, and that measures proper to allay inflammation are the best preventives of ankylosis. Immobilization of a joint with counter-extension is frequently practised for years without intermission in the treatment of joint disease, with the result of cure with good motion. Premature attempts at passive or active motion during the continuance of inflammation will surely increase ultimate stiffness by adding fuel to the inflammatory process. Similar considerations apply to the employment of movements active and passive after fractures involving a joint. The proper treatment of such cases is perfect immobilization, with extension, if necessary, and local exercise only after healing has taken place.

There are several non-inflammatory orthopædic affections where prescribed exercise is of great value, particularly lateral curvature of the spine, the disabilities following acute poliomyelitis, and flat foot. Exercise and general hygiene are of the utmost importance in the treatment of lateral curvature, and in the milder cases without bony deformity are alone sufficient. Errors of living tending to depreciate the general vigour and to overwork the organism in the vulnerable growing period must be corrected, piano practice stopped, school hours shortened, and a free open-air life provided. To these should be added in all but the simplest cases special exercises for expanding the chest and developing respiratory capacity, and also corrective exercises whose object is to utilize muscular activity and the weight of the body in correcting the abnormal deviation, as in trunk flexions and in lateral and other forms of suspension. While the patient is in a corrected position the weakened muscle groups are to be developed. Many exercises are best given while the patient is seated or lying on a flat surface. In general those exercises which stretch or raise the arm on the side of the low shoulder and stretch the leg of the high hip are to be employed. So high an authority as Noble Smith denies the special value of the Swedish exercises in correcting deformity in severe cases, and refers observed benefit to the general effects of exercise. In those severer cases with bony deformity some form of corrective supporting apparatus to be worn on the person will sometimes be needed, but the compression may easily do harm unless respiratory, corrective, and developmental exercises are added. In prescribing exercises extreme care should be used not to overfatigue the patient. The exercises should not be too severe or of long duration, and short periods of rest in the recumbent posture should be so distributed that the total result shall be invigoration; otherwise the exercises, however excellent in themselves, may do harm.

The disabilities following acute poliomyelitis are often exaggerated by the irregular distribution of the paralysis, which often enforces passivity on muscular groups that would otherwise be efficient. This unbalanced condition of opposing groups conspires with other causes to produce deformities which require to be corrected before the muscles can be developed. Appropriate apparatus is used to sustain or supplement weakened parts, as, for example, when the knee is mechanically fixed in paralysis of the quadriceps, in order that by making locomotion possible the still efficient muscles and centres may be brought into action, and that the patient may enjoy the benefit of the local and general effects of exercise. Children who have been confined to a chair for years are often enabled to walk very well by thus mechanically supplementing impotent parts. The purpose of apparatus in these cases is not merely to stiffen an otherwise unstable joint, but, by so doing, to bring into action muscles and centres that would otherwise be condemned to continuous inactivity owing to the weakness of co-operating or opposing groups.

Flat foot of moderate grade can be cured by exercises alone. These should be so selected as to bring into action the inverters and adductors of the foot. Rising upon the balls of the feet and then turning the heels outward while in the standing position is an excellent corrective and developing exercise, as is also walking with the toes pointed forward instead of outward, so as to transfer more of the weight to the outer border of the foot. Carefully adapted exercises faithfully practised will often render mechanical or surgical treatment unnecessary even in cases of considerable severity. An interesting addition to the class of cases which can be most successfully treated

by properly chosen local exercises is found in certain laryngeal disorders associated with hoarseness or loss of voice, as recently noted by Dr. H. Holbrook Curtis. He says: "For a number of years I have deluged the throats of singers with sedative and astringent sprays when their cords appeared congested and swollen, ofttimes presenting nodules in their centres which I had never previously recognised as being due entirely to singing with an improperly poised larynx." He now treats such cases with vocal and respiratory exercises appropriate to establish correct laryngeal poise with inferior costal or diaphragmatic breathing.

Considerable use has been made of exercises of the muscles of the waist and thighs, with and without local massage, in the treatment of certain uterine disorders, and with encouraging results. The treatment of hernia by means of systematic exercises also has its enthusiastic advocates.

While we are still very far from mastery of the scientific application of exercise to the relief of general and local disorders, enough has been accomplished to encourage more accurate and extended work in this field of brilliant promise for the future of therapeutics.

Henry Ling Taylor.

EXHILARANTS are agents which produce mental and bodily exaltation. The exhibition of "high spirits" is often dependent upon a number of circumstances which are scarcely to be considered therapeutical in nature; youth, health, previous rest and sleep, occupation, atmospheric and mental conditions, in particular contribute to the production of hilarity. Strictly speaking, therefore, such factors are exhilarants, but in the clinical sense the term is restricted to remedies which produce the phenomena mentioned. The mildest of these, and one which is scarcely more remedial than some of those already referred to, is the cold bath, the reaction after which, as is well known, brings with it that sense of content, lightness, cheerfulness, and vigour which makes the application of cold water so valuable both in health and in disease. The typical medicinal exhilarant is alcohol, and the enlivening result of its consumption in small quantities is too familiar a thing to require more than mention. Cannabis indica is similar in its action, though the manifestation of its power to exhilarate is observed only after the use of full doses, and the employment of such doses is rare save in the East. Although the usual effect of opium is to calm, exhilaration may result from its use; but such an occurrence is witnessed only in those possessed of an idiosyncrasy for the drug and those who employ it habitually. Cocaine will act to exhilarate when taken in sufficient amount, and belladonna and stramonium may be said to do the same, though it is delirium which results from their use rather than exhilaration. Besides these there are many other remedies which will produce exhilaration at times, but rather because of susceptibility and idiosyncrasy in the patient than because of exhilarant power inherent in the drug. Tea, however, as well as coffee, will not rarely manifest this power. The employment of exhilarant drugs is not so much in their use as in their abuse, and in the alcohol habit, the cocaine habit, and the "hasheesh" habit of the East we have abundant evidence of the powers as well as the dangers of exhilarants.

The cultivation of a physiological exhilaration is highly to be desired, and all hygienic and curative means which will properly contribute to this end are in constant employment. Even mild exhilarant drugs, such as tea and coffee, may be permitted or ordered with propriety, but the prescribing of those active and potent remedies of which I have spoken, for the production of their pleasurable effects alone, is both impermissible and disreputable.

Henry A. Griffin.

EXODYNE.—This is a proprietary antipyretic and analgetic said to consist of 90 parts of acetanilide, and 5 parts each of salicylate and carbonate of sodium.

EXPECTANT TREATMENT consists in putting a patient in as good a state and as comfortable a condition as possible and then awaiting developments. It is applicable in the absence of positive therapeutic indications. Practically, therefore, by expectant treatment is meant non-interference, or no treatment at all. However necessary this inactivity may be, and unfortunately it often is necessary for a time and pending the development of a disease, it is certainly unsatisfactory and unscientific. With the rapid advances in pathology and therapeutics, however, expectant treatment is each year found necessary in a smaller number of ailments. That the number should still further be reduced is much to be desired, for, though in a disease which is self-limited and manifestly making for spontaneous cure there can be no disadvantage in "leaving it to Nature," it is hardly satisfactory to so often be compelled to acknowledge our helplessness, and, moreover, Nature unaided often does not suffice to cure. The expectant treatment is therefore an apology and a makeshift, better, of course, than meddlesome therapeutics, but in no sense a substitute for rational and scientific treatment.—Henry A. Griffin.

EXPECTORANTS.—These are usually divided into two classes, the sedative, depressant, or nauseant, and the stimulating expectorants; by some a third class is added to include agents which act upon the respiratory centres and stimulate somewhat the coughing necessary to expel the secretions of the air-passages. The members of the first group are all emetic and nauseant, and include apomorphine, ipecac, antimony, and lobelia, the two latter being rarely employed on account of their depressant effects upon the general economy. Antimony in the form of tartar emetic may be employed in the plethoric when the skin is hot and dry, but presents hardly any advantage except in the slight bulk required. Ipecac and apomorphine hydrochloride are probably the most suitable remedies of this class, the first-named being the safest, especially for administration to children.

To obtain the greatest benefit, small doses, of whichever drug of this group is selected, should be given hourly in ordinary cases. In the more acute conditions, when occurring in adults of strong constitutions, sufficient quantities are to be administered and at such intervals as to excite a slight feeling of nausea. In suffocative conditions, such as *croup*, both the relaxing and the expelling effects of an emetic are desirable, but caution is to be observed in selecting one which is as little depressant as possible. Hence ipecac and turpeth mineral, although the latter is not ordinarily regarded as an expectorant, are more appropriate. As might be expected, the early stages of nearly all the *acute inflammations of the larynx* and *bronchi* are the conditions in which this class of expectorants will prove useful. The relaxation of the unstriped muscular fibres expedites exudation of the mucus, and the disease runs a much shorter course than if left to itself.

In the *bronchial affections of children* these expectorants are more strongly indicated than in adults, as coughing with children is more largely reflex than voluntary, and the bronchioles are more liable to become clogged with secretions. Generally it will be found that laxatives assist the action of nauseant expectorants, but they should not be carried to the point of active purgation. Alkalies are reputed to increase the bronchial secretion and render it less viscid, and they may be employed as adjuvants. The alkaline carbonates mixed with lemonade and drank while effervescing furnish a ready means of administering them, and they will probably have a slight laxative effect. Steam, especially that given off when hot water is poured upon unslaked lime, undoubtedly is beneficial in the early stages of catarrhal affections of the air-passages, and in any event is grateful to the person, relieving the irritation caused by the contact of the air with the inflamed mucous membrane.

It is especially valuable in true and false *croup*, the air of the apartment being saturated with it. As a rule, opium should not be combined with or administered at the same time as nauseant expectorants, except in cases where the coughing is severe and apt to exhaust the patient.

The unofficial syrup of licorice is very commonly used as a vehicle for these remedies, and, being slightly nauseating to most persons, may be regarded as an adjuvant; it makes little difference, however, in what form they are used. It is not uncommon to combine two or more members of both groups of expectorants, but it is much better to employ a single one or at most two at the appropriate time—the nauseant expectorants when the mucus is scanty and viscid, and the stimulating when the reverse conditions exist.

The selection of an appropriate stimulant expectorant is rather perplexing, as their number is very large and nearly all depend for their action upon their containing volatile principles which are excreted by the bronchial mucous membrane, and have a local tonic and stimulant effect upon it. Squill, senega, ammoniacum, galbanum, serpentaria, sanguinaria, asafœtida, oil of turpentine and its derivative, terebene, are the most active members of this division. Peruvian balsam has some slight effects in this direction, but is not much used, and when employed must be combined with gum of some sort to form a kind of emulsion. Balsam of Tolu is only slightly expectorant, but its syrup supplies an agreeable vehicle for almost any form of cough mixture. The inhalation of its vapour sometimes allays cough and diminishes the secretion of chronic bronchial affections. Squill occupies a position almost intermediate between the nauseant and the stimulant expectorants, and may often be employed to advantage during the entire course of a bronchitis. Ammoniacum, asafœtida, and senega are probably the best of those above mentioned, and there is little to choose between them. Copaiba is sometimes used when the secretion is excessive; it is an active stimulant of the mucous membrane. Cubeb is reported to work well in chronic cough. Inhalation of the vapour rising from hot water containing benzoin or benzoic acid promotes expectoration, and is usually an agreeable and soothing procedure for the patient. Eucalyptol and the oil of eucalyptus are often used with good results in the chronic affections of the respiratory tract, especially when the cough is spasmodic, and may be given either internally or by inhalation. Oil of turpentine is particularly indicated in *chronic bronchitis*, especially when the secretions are purulent and profuse. It may be administered internally or by the inhalation of the steam rising from hot water combined with small amounts of it. However used, it is actively stimulant and may give rise to unpleasant sensations in the larynx and to rather more coughing than is desirable. It may also be administered by means of an atomizer. It sometimes, however, increases the laryngeal secretions, when a drop or two are taken on sugar, and thus relieves the dry hacking cough so common in damp cold weather due to slight *laryngitis*. Terebene hydrate has essentially the same properties, but is somewhat easier of administration, and forms a rather more elegant preparation. The vapour from hot tar-water is slightly expectorant, and also tends to lessen coughing in almost all the bronchial affections. Ammoniacum, asafœtida, and galbanum resemble each other closely in action, and are especially indicated in *spasmodic cough*. Sanguinaria and serpentaria are not decidedly stimulant, but are used to some extent, particularly in *capillary bronchitis* and in *pneumonia* when liquefaction of the exudation has occurred. When a vehicle for an expectorant mixture is needed there is probably nothing so agreeable and elegant as the syrup of lactucarium. As a rule, it is not well to flavour these mixtures with any of the volatile essential oils, as they in themselves have stimulant expectorant properties.

Ammonium chloride is probably more freely used as an expectorant than any other drug; being eliminated by the lungs, it is assumed to act as a stimulant of the bronchial mucous membrane, and is also believed to liquefy its secretions. It is particularly indicated in *chronic bronchitis* when the mucus is thick and

tenacious, and sometimes it is advantageous to administer it by means of an atomizer. Its disagreeable taste is rather a drawback to its use, and it should be well disguised with licorice or some similar substance. Ammonium carbonate is almost identical with it in action, and, being slightly stimulant, is particularly indicated in adynamic states. It is usually given in combination with senega. There are some reasons to assume that these ammonium salts act upon the respiratory centre and stimulate the reflex sensibility of the lungs.

Opium or morphine is a very valuable adjuvant to nearly all expectorant mixtures when the cough is irritating or painful, but considerable caution should be exercised in selecting the cases in which it is proper to use either of them. With free expectoration, when a dusky hue of the skin exists, it should hardly be used, as during the sleep which follows its administration the bronchial secretions may accumulate to such an extent as to cause suffocation. Capillary bronchitis and the extremes of life also contra-indicate its use. When, however, there are no symptoms of insufficient oxidation of the blood and the patient is robust, it may be used with considerable freedom and with good results. The reflex sensibility of the bronchial tubes is lessened, and consequently the frequency and violence of the cough diminished, which latter increases the vascularity of the parts affected, and secondarily their secretions.

Dilute hydrocyanic acid, although not expectorant, often acts admirably in relieving cough. It may be used to advantage in nearly all cases in which the cough seems to assist in keeping up the irritation of the bronchi. It should be borne in mind that the proprietary cough mixtures, of which there are so many in the market, contain, almost without exception, opium or tartar emetic, or both, and are highly dangerous, especially to children and infants.

RUSSELL H. NEVINS.

EXTRACTS.—The solid extracts, which are generally meant when the word extract is employed, are commonly made by evaporating fluid extracts to a pilular consistence, and they are mostly used as ingredients of pills, although some of them are allowed to become dry and hard and then powdered. (Cf. ANIMAL EXTRACTS AND JUICES.)

FABA CALABARICA, *Faba Sancti Ignatii.*—See PHYSOSTIGMA.

FABIANA IMBRICATA.—See PICHI.

FARADIZATION.—See under ELECTRICITY.

FARFARA.—See TUSSILAGO.

FATS, or the unctuous bodies solid or semifluid at ordinary temperatures and furnishing glycerin when saponified, have in a measure been supplanted in many pharmaceutical processes by the various petroleum products of which vaseline is the type, but they are more suitable for use in the cases in which ointments, cerates, etc., contain remedies which are to be absorbed by the skin, as all the animal and vegetable fatty and oily bodies assist in their absorption. On the other hand, when a local effect is desired the petroleum products are preferable, since, when properly prepared, they are bland and unirritating and never become rancid, an accident to which all the true fats and oils are liable.

Extreme care in preparation delays the occurrence of rancidity, or decomposition of a fat into the fatty acids and glycerin, but it is sure to occur in a relatively short period unless the access of light, moisture, and air is entirely prevented. It is easy to see that, whenever a rancid fatty body is applied to a raw surface or to a mucous membrane, the fatty acids must act as irritants, and in many instances neutralize the effect of the various agents with which the fat is combined. When rancid fat is applied to sound surfaces little harm is to be apprehended, although delicate skins might be irritated to a considerable extent. Therefore when ointments, etc., containing antiseptics, astringents, and the like, are to be applied to raw surfaces or to mucous membranes, vaseline or some similar substance should constitute their base.

Rancidity may be prevented to a certain extent by the addition of a number of substances, of which benzoin, balsam of Peru, poplar buds, and oil of pimenta are the most commonly employed and the most useful, but, as they all are more or less odoriferous, there is some danger that they may simply mask the odour of the products of decomposition without neutralizing their ill effects.

Of all the animal fats, lanolin is probably the least irritating to the skin, and is peculiarly applicable in all cases as a vehicle for agents expected to act directly upon the surfaces to which they are applied. Wax and spermaceti, although not fats in the ordinary sense of the word, are used to a considerable extent to give consistence to cerates and ointments. They are, when pure, entirely free from any irritating properties, and may be used in all cases. The same may be said of paraffin, which, being a petroleum product, is rather more indicated when vaseline is to be rendered more consistent. It is sometimes used in the preparation of an artificial vaseline. Stearin, as prepared in the manufacture of oleomargarine, may be used in the same manner as wax and spermaceti, and, when properly prepared from fresh fat, is entirely unobjectionable. It is of about the same consistence as wax, and is almost without odour or taste. It is largely used to give body to the cheaper grades of lard, and, combined with cotton-seed oil, constitutes the various substitutes for that product. Lard is, of the animal fats, the most difficult to procure free from adulteration and made from the best grades of fat, and becomes rancid sooner than any. Mutton tallow is popularly held to have virtues peculiar to itself, but it has no particular advantages beyond that of being firm and remaining so at ordinary temperatures. That which is made at home from the fat of mutton

removed before the joint is cooked is by far the best, and if kept in a cool place remains sweet for a considerable length of time. It presents the slight disadvantage of giving off the odour of strong mutton if used upon parts of the body not exposed to the air, as in the axillæ, but, in the absence of the more elegant cold cream, it is the best application to *chapped hands*, *cracked lips*, and parts exposed to injury by pressure or friction.

Beef suet is not very desirable, as it is very apt to become rancid in a short time and is not of a consistence suitable for ointments, etc., when used alone. When nothing else is procurable, wax or spermaceti may be added to stiffen it, but under no circumstances should the commercial article be used, as it is rarely free from the fatty acids. Cacao butter, or the *oleum theobromatis*, is extensively employed for coating pills, for cosmetic preparations, and for suppositories, for which purposes its low melting point and agreeable odour render it particularly suitable. The fats of the common skunk, goose, turkey, etc., are held in high esteem among country people for earache, inunction of stiff joints, etc., but are entirely without any peculiar virtues. Having a low melting point, they are easily manipulated, but are apt to have a rank, unpleasant odour.

Almost every animal and vegetable fat and oil has been employed by inunction in the various febrile states, more particularly *scarlet fever*, and probably one is as good as another, but cacao butter is the least apt to become very offensive, and, when procurable, is the one most often used. In some localities salt bacon and pork have been used, but they are irritating to the skin and are apt to be the source of very unpleasant odours shortly after their application. It is clearly established by observation that inunctions in *fevers* relieve irritation and are antipyretic, but whether they have any specific effect in reduction of temperature is not clear. It is probable, however, that the feeling of *bien aise* which follows gentle rubbing of the person, both in health and in sickness, is the most important factor. To obtain the full benefit from these inunctions the body should be bathed, when practicable, with a weak solution of washing soda (sodium carbonate). Usually the number of inunctions should not exceed two in each twenty-four hours, but there is no objection to a larger number, provided the fatigue and exposure do not appear to counterbalance the benefit derived from them.

Aside from their therapeutical effect in scarlet fever, fatty inunctions play an important part in preventing the scattering around of the scales resulting from desquamation, and thus diminish the danger of spreading the disease. It is an advantage in this disease and also in *measles* to add a little carbolic acid to the fat used. In massage of joints, etc., it is often necessary to use something of the nature of a lubricant, and for this vaseline is better than animal or vegetable fats, as it is odourless. The smallest amount possible should be used in these conditions, and only at the beginning, as a considerable proportion of the good gained depends upon the mild amount of counter-irritation set up. For inunctions to assist in the nutrition of the body, cod-liver oil is by far the best agent, but its disagreeable odour renders it difficult to induce people to persist in its use. Rich cream may be substituted, but should not be applied around the axilla, the groin, or other parts where the skin is in folds or creases, as it is very prone to undergo the butyric-acid fermentation. These inunctions are best done at night and should be preceded, and followed in the morning, by a warm bath. Some form of woollen night clothes should be worn, as otherwise the bedding is sure to be soiled. Inunctions to protect parts from friction or from the irritation of the urine, etc., are best made with vaseline, stiffened a little with wax or spermaceti, so that its melting point may be raised somewhat and its tendency to run or rub off diminished. Nothing is gained by using for this last purpose more than sufficient to cover the parts completely. Thoroughly greasing the nostrils and upper lip will usually prevent the discharges of nasal affections from causing raw and excoriated surfaces. Chafing and blistering of and uncomfortable sensations in the feet of those who walk long distances may be in a measure prevented by greasing the socks with some animal fat, but a clean pair must be worn each day and the feet thoroughly freed from the fat at night by washing with warm water.

Fat enters largely into the composition of nearly all the tissues and is a very necessary element of dietaries, although it is pretty well established that what is taken with the food is not the sole source of that in the body. The carbohydrate elements of food are in part converted into fat, and in addition a certain amount is derived from proteids. It makes little difference, so far as the deposit of adipose tissue and the metabolic changes in the body are concerned, in what form fat is ingested: it may be animal or vegetable, or consist of palmitin, olein, or stearin, as in the changes it undergoes during digestion and assimilation it is always converted into a body of practically the same chemical and physical properties. It aids very materially in the mechanical preparation of the food, converting it into an emulsion, and, while that derived from the carbohydrates may be sufficient for the wants of the body, the absence of fat from the food is attended with imperfect digestion. Therefore in all conditions characterized by loss of flesh and strength it is strongly indicated, both to supply the waste and to aid in digestion. It is also probable that a diet lacking in fat is more apt to be followed by constipation.

In addition to the other elements, about ½ oz. of fat is necessary for the average individual when leading a quiet life and about 3 oz. when engaged in labour or active exercise. This latter amount is well represented by the 3½ lbs. of dry salt bacon serving as the weekly allowance of negroes employed in farm work, etc., in the Southern States. When a suitable amount of fat is eaten, the quantity of nitrogenous elements may be lessened to a considerable extent. The part which fat plays in

increasing the adipose tissue of the idle is quite important, but in the active it is of slight moment, as the races that use it in the largest amounts are the ones in which adiposity is not the rule. The inhabitants of the countries bordering on the Mediterranean, negroes, and other races use it in rather larger quantities than the average individuals of nearly all other civilized peoples; yet they are capable of great endurance, and, as a rule, the working classes are as strong. An excess is apt to be followed by decomposition of a portion of it into the fatty acids and consequent indigestion.

When what might be termed pathological emaciation exists, the most suitable form in which fat can be employed is that of cod-liver oil, but in the convalescence from ordinary acute disorders it may be dispensed with and larger amounts of butter than are usually used may be substituted, and the use of cream and other articles of a fatty nature encouraged. Smoked bacon is usually relished and is very useful in such conditions. For infants cream is probably the best form in which fat can be given.

In cooking, lard, or what is called lard, is oftener used than anything else, and when "straight" and well made it is probably as unobjectionable as anything, but salt pork or bacon, not smoked, is preferred by many, as it imparts a more agreeable flavour to nearly all articles cooked in it. For pastry, shortened biscuits, etc., it is hardly suitable. Cotton-seed oil or olive oil is preferred by many for fish and other articles the process of cooking which is rather one of boiling than of frying, and for such purposes the oil may be employed again and again, provided that when it has been used for fish it is kept for that purpose alone. Mutton fat is unsuitable for cooking, as it imparts a muttonlike flavour to the food. Drippings from beef may be used for frying when a dark colour is not objectionable, and with care they may be used a number of times.

Russell H. Nevins.

FEBRIFUGES are remedies which diminish febrile temperature. The name febrifuge is synonymous with antipyretic, but habit has established a quasi-distinction between the two, and antipyretics may be said to be remedies of great power against fever, and particularly that class whose introduction is recent and whose derivation is from coal tar, while febrifuges are rather mild remedies. Antipyretics, too, act in some cases to diminish heat production as well as to increase its dissipation, while febrifuges reduce fever heat rather by increase of heat dissipation and mainly by their action as vascular sedatives and as diaphoretics. These distinctions are, however, rather those of fancy than of fact, and the actual difference between febrifuges and antipyretics is not apparent, for, regardless of drugs of recent introduction, both names apply equally to remedies which reduce fever; febrifuge is a term our medical ancestors used, while antipyretic is its modern synonym.

The febrifuge drugs in use in former years are, as I have said, principally those which produce circulatory sedation, such as aconite and veratrum viride, and those which cause perspiration, notably sweet spirit of nitre and spirit of Mindererus. Quinine, too, was often described as a febrifuge. Besides drugs, there were employed, and still are, a number of procedures which are febrifuge, some of them by virtue of diaphoresis. Of these the old-fashioned sweat is an example, as are also hot drinks and the mustard foot-bath. The alcohol-bath or the alcohol-and-warm-water sponge is in like manner febrifuge, though not by diaphoresis. From this somewhat limited armamentarium the number of febrifuge drugs and measures has rapidly increased with years until by the discovery and introduction of some of the coal-tar preparations the class has come to include a considerable number of active reducers of temperature, now known as antipyretics.

The therapeutical employment of febrifuges is for the reduction of fever, and they are appropriate whenever the temperature is such as manifestly to add to the patient's discomfort or his danger. Contra-indications to their employment are few and practically confined to extreme exhaustion and circulatory weakness. So far as the "febrifuges" of the past are concerned, their power to reduce temperature in itself was limited, for cool sponging, diaphoresis, and safe vascular sedation will not compare in activity with the action of the modern antipyretics, and sweating and the use of vascular sedatives are certainly not suited to continued employment. In slight fevers, "febricula" and those rises of temperature which so often follow exposure and indigestion, especially in children, the sweat or the foot-bath, nitre and aconite, with the purge, which was generally their accompaniment, were and are in a high degree efficient and febrifuge. (See Antipyretics.)—Henry A. Griffin.

FEBRILINE.—This is a proprietary preparation sometimes called "tasteless quinine," said to consist of a lemon syrup free from acidity and holding in solution a moderate amount of quinidine.

FEEDING.—See Alimentation, Dietetic Treatment, Foods, Milk, etc.

FEL BOVINUM, *Fel tauri depuratum.*—See Ox gall.

FENNEL.—See Fœniculum.

FERN, MALE.—See Aspidium.

FERRATIN.—Schmiedeberg, of Strassburg, gave this name to an organic iron compound isolated by him from the liver of the pig. It is now made by the action of iron and potassium tartrate, together with caustic soda, on white of eggs. It is said to be an acid albuminate of iron, and is thought to be converted into the sesquichloride by the process of digestion. It is an odourless and tasteless brown powder of neutral reaction, containing from 6 to 10 per cent. of iron. Schmiedeberg recommended it as a readily assimilable preparation of iron, indicated as a remedy in cases in which the ordinary preparations of iron would be applicable for their tonic action. A

number of observers have reported its favourable operation in cases of *anæmia* and *chlorosis*, notably Mr. John Harold, of London (*Practitioner*, Aug., 1894), who gives notes of three cases and states that in none of them did the administration of ferratin produce any digestive trouble or constitutional disturbance. He emphasizes the importance of rest in the treatment of chlorotic anæmia, and, after remarking how difficult it is to decide upon the relative value of medicinal preparations of iron in these cases, inasmuch as many of them end in spontaneous recovery without any medicinal treatment whatever when the patients have been placed under favourable hygienic surroundings, he goes on to say: "As yet but little is known as to how the assimilation of iron is regulated by the organism, and we are also more or less in the dark as to the conditions and form of its absorption. Until our knowledge on these points has been advanced, no definite pronouncement can be made or verdict given as to which iron compound will be our ideal therapeutic preparation. According to Bunge, inorganic iron is solely of use in combating and neutralizing the hydrogen sulphide present in the alimentary canal, the hæmoglobin present in the red blood-corpuscles deriving its iron constituents from the organically combined iron in our food. In other words, the hydrogen sulphide is prevented from robbing the food of its organic iron. Intestinal antiseptics accordingly might prove of equal efficacy with our usually prescribed inorganic iron compounds, and it has been found that when prescribed they have indirectly increased the formation of the hæmoglobin. With iron, as with many other drugs, apparently trivial differences in the methods and form in which it is administered, and the dosage in individual cases, not unfrequently produce a great difference in the result obtained. The full recognition of this important fact should ever be before our minds; and it is because of want of proper attention to what may, at first sight, seem a small detail—the form of administration of our therapeutic measures—that we so often fail to derive the desired benefit. It can not but be acknowledged that inorganic iron as generally prescribed cures anæmia in the majority of cases, but some preparations undoubtedly yield better results than others. How the inorganic iron acts in cases of chloranæmia is doubtful, but most likely its *modus operandi* is that already explained. Remembering that the liver of many animals naturally contains a highly ferrated compound, and that the liver performs a ferrogenic function in storing up iron from the blood of the portal vein—a fact so constantly observed in cases of pernicious anæmia—possibly excreting it when the needs of the economy require it, it is interesting to note the effects of the artificially prepared ferratin. This, as Prof. Schmiedeberg has related, is the outcome of the endeavours made by him to administer iron in 'organic' combination, and it certainly appeared to exert a remarkable hæmatinic effect in the cases recorded."

M. Germain Sée corroborates the testimony of others in favour of ferratin, also Schmiedeberg's statement that it is applicable not only in chlorosis and anæmia, but as an alimentary substance in those apparently healthy subjects who simply need "toning up." No deleterious or cumulative effects have been observed from it. The dose is from 8 to 30 grains.

FERRIPYRINE.—See FERROPYRINE.

FERROHÆMOL, *hæmolum ferratum*, according to Kobert (cited in *Therap. Woch.*, Mar. 3, 1895), is a brown powder containing iron in two states, one of which is that of a stable organic combination. It is used as a tonic where a readily assimilable preparation is required, in doses of 8 grains three times a day, shortly before eating.

FERROPYRINE.—Hederich, of Heidelberg (*Therap. Woch.*, Jan. 6, 1895; *Lyon méd.*, Feb. 17, 1895), recommends a new hæmostatic called by this name. It is said to be a definite combination of iron perchloride and antipyrine under the form of a reddish orange-coloured powder which is easily soluble in cold water, and to have several appreciable advantages over iron perchloride, for it has neither its caustic qualities nor its bad taste; its hæmostatic properties are, moreover, said to be superior to those of the perchloride. In a case of profuse *hæmorrhage* caused by a very vascular myxoma of the nasal cavity the application of two tampons saturated with a 20-per-cent. solution of ferropyrine was sufficient to arrest the flow of blood completely. It may be employed internally in doses of 8 grains. Hederich thinks that it should be tried in cases of *blennorrhagia* in injections of a 1-per-cent. or a 1·5-per-cent. solution.

FERRUGINOUS PREPARATIONS, FERRUM.—See IRON.

FICUS (U. S. Ph., Br. Ph.), **FIGS.**—Figs are esteemed slightly laxative. The pulp enters into the composition of confection of senna.

FILIX MAS.—See ASPIDIUM.

FIR WOOL is a woolly, fibrous substance obtained from the leaves of *Pinus silvestris* and other European firs or pines. It is used as a local application in *chronic rheumatism*, the affected part being enveloped in a thick batting of this material. This wool has also been woven into a cloth and made into clothing, and an extract has been made from it which has a limited popular use. There is no evidence that fir wool is better than ordinary cotton batting or woollen cloth, and it has no specific influence in rheumatism.

[Fir-wool oil, *oleum pini sylvestris* (Br. Ph.), is distilled from the fresh leaves of *Pinus silvestris*. It is the essential ingredient of the *vapor olei pini sylvestris* of the Br. Ph.].

SAMUEL T. ARMSTRONG.

FLACOURTIA.—The leaves of *Flacourtia cataphracta*, an East Indian bixaceous plant, are esteemed tonic and astringent in *diarrhœa* and *general debility*, and have been recommended as a remedy for *hoarseness* and for *nausea*. An unofficial tincture is prepared with 1 part of the leaves and 5 parts of alcohol, of which the dose is ½ fl. drachm.

FLAG, BLUE.—See IRIS.

FLAG, SWEET.—See CALAMUS.

FLAXSEED.—See LINSEED.

FLOUR is a fine powder of a cereal grain. That most used is wheat flour, the ground and sifted grain of *Triticum sativum*, and it is official in the Br. Ph. as *farina tritici*. It is inodorous, almost insipid, and its colour varies from pure white to a dusky white. It contains starch, gluten, saccharine matter, albumin, and gum, the proportions of which vary with different grades of wheat. Flour made from the whole grain contains soluble phosphates, principally potassium and magnesium phosphates, and insoluble iron and calcium phosphates. These, as well as a ferment which changes starch into sugar, are lost in making the fine grades of table flour.

Bread is made by making flour into a dough with water, etc., and adding yeast. The dough is set aside for some hours to ferment; in the fermentation excited by the yeast carbonic-acid gas is formed, and numerous small spaces are formed in the dough, which is exposed to heat to make bread.

Wheat flour is seldom used in medicine; it is a popular application in *burns* and in *erythematous* or *pruritic eruptions*.

Baked flour is a preparation which is made by baking wheat flour in a slack oven until it acquires a pale-buff hue. It is used as a food for infants affected with *diarrhœa*.

Boiled flour is prepared by tying fine flour in a linen cloth as tightly as possible, and dipping the bag frequently into cold water and covering its outside with flour until a crust is formed which will prevent the water soaking into the bag; the bag is then put into boiling water and allowed to boil for some time. When cold, the flour is divided into small oblong pieces which are rolled into powder when used. It is a useful food for young children that have a tendency to *gastro-intestinal indigestion*.

Flour gruel is made by mixing a tablespoonful of flour with enough milk to make a smooth paste, which is stirred into a quart of boiling milk and boiled for half an hour. Salt is then added to season it and it is strained. It is used, with or without malt extract, in *diarrhœa* and *dysentery*.

Boiled-flour gruel is made by grating two tablespoonfuls of flour from a boiled-flour ball, making it into a smooth paste with cold water, and stirring it into ½ a pint of boiling milk. It is allowed to simmer for a few minutes and then it is sweetened. It is used in *gastro-intestinal disorders*.

Flour soup is made by adding sufficient flour to cover a lump of butter melted in a skillet, and, when the flour is thoroughly browned by the heat, adding a cup of milk and water and boiling the mixture. It is strained, salt is added, and it is served hot. It is used as a food for invalids.—SAMUEL T. ARMSTRONG.

FLUORESCEIN is the name of a substance obtained by heating equal weights of resorcin and phthalic anhydride to a temperature of 200° C.

Probably the substance thus produced is not always the same, because there is a difference not only in various descriptions of the drug, but also in the given chemical formulæ. The colour is described as yellow, yellowish brown, dark brown, and brick-red. According to some writers it is crystalline; others say it occurs in powder or in flocks. One author says it is not very soluble in alcohol, another that it is readily soluble in alcohol. Three chemical formulæ given to indicate its composition are $C_{20}H_{14}O_6$, $C_{20}H_{12}O_5$, and $C_{20}H_{15}O_5$.

Another source of the confusion which surrounds this subject arises from the fact that many authors confound fluorescin with fluorescein, while those who distinguish between them do not seem to be agreed as to what the distinction should be. One author says that fluorescin is a yellow powder formed by heating fluorescein with a solution of caustic soda and zinc dust; another, that it is a colourless acid. It is evident from the foregoing that a positive description of either fluorescein or fluorescin can not be given, but that which seems to me to be probably as nearly correct as can be found at present is the following: Fluorescein occurs in at least two forms, one, $C_{20}H_{14}O_6$, occurring as yellow flocks, the other, $C_{20}H_{14}O_6—H_2O$, as a brick-red, crystalline powder. Fluorescin is a colourless acid, $C_{20}H_{14}O_5$, soluble in ether.

A common property of all these substances, that are so closely allied, is that of imparting a rich green fluorescence to alkaline solutions. Another property which appears to be held by them almost in common is that of staining green an abraded corneal surface, but all varieties do not seem to possess it to an equal degree. The red variety is the one recommended and used to a certain extent in ophthalmology. It has no direct therapeutic value, to the best of our present knowledge, but, as it is non-irritant and produces no bad after-effects, it is useful to mark plainly the exact area of an ulcer of the cornea which is to be cauterized, to detect minute corneal ulcers, and to show accurately the position of a minute foreign body, and so facilitate its removal from the cornea. In all these cases the abraded surface is stained green and shows plainly in contrast with the normal corneal tissue which surrounds it. It is said that the corneæ of the dead will take the staining, although those of the living will not except when abraded, and hence its use has been suggested as a test to determine when death has occurred. Fluorescein has also been used to test the permeability of strictures of the nasal duct.

The solution usually recommended is one of 10 grains of fluorescein and from 7 to 15 grains of sodium bicarbonate to 1 ounce of water.—MATTHIAS LANCKTON FOSTER.

FLUOROL, or *sodium fluoride*, is a bluish-white salt, odourless and soluble in water. M. Duclos (*Presse méd.*, Sept. 14, 1895) has used it in the treatment of *dacryocystitis* in its different stages. A 1-per-cent. solution, he reports, instantly and definitely arrests vital fermentations, but does not suspend chemical fermentations. A 1-per-cent. solution, and even a

solution in the proportion of one in two hundred, prevent the development of pyogenic bacteria. M. Duclos thinks fluorol is preferable to corrosive sublimate, to nitrate of silver, to potassium permanganate, and to formol, because injections of it into the lacrymal ducts are not painful, and especially because of the curative effects obtained by him. M. Lagrange (*ibid.*) thinks that the good results obtained by fluorol in the treatment of dacryocystitis, where injections of corrosive sublimate have failed, are due to the fact that fluorol does not coagulate the albumin, and the microbes are not protected against its action by a covering of albumin. Furthermore, the mucous membrane of the lacrymal ducts tolerates, without the least reaction, injections of fluorol, which are not caustic or painful. It is said not to provoke the slightest irritation.

FŒNICULUM (U. S. Ph.), *fœniculi fructus* (Br. Ph.), *fructus fœniculi* (Ger. Ph.), fennel, is the dried fruit of *Fœniculum capillaceum.* It is a mild carminative. Fennel water, *aqua fœniculi* (Br. Ph., Ger. Ph.), may be given in doses of from 15 to 40 drops. The dose of the volatile oil, *oleum fœniculi* (Ger. Ph.), is from 1 to 10 drops given on sugar.

FOMENTATIONS are liquids applied to the surface of the body by means of some absorbent material, usually cloth. The liquids so applied are generally warmed. The name stupe is often applied as synonymous with fomentation, but though the distinction is of little practical importance, there is, strictly speaking, a difference, a fomentation being the liquid applied, while a stupe is the absorbent material which conveys it.

In former years a large number of medicinal fomentations were in use, some of them official, and the *fomentum commune*, or *fomentum discutiens*, of old pharmacopœias was a mixture of alcohol, vinegar, camphor, and honey. A few medicinal fomentations indeed are still recognised by the Fr. Cod., but the general belief is now that medicinal fluids so applied are not active save as they may be irritant, and that the effectiveness of fomentations is not determined by their medicinal ingredients but by their heat. For these reasons fomentations at the present time usually consist of hot water applied on cloths or sponges, to which an irritant is sometimes added, oil of turpentine in particular.

In preparing a fomentation flannel is usually employed. A piece of suitable size is dipped in boiling water, wrung out, and immediately applied. To aid in the wringing out, a process which would otherwise be painful, a stout towel is fastened to two strong rods, and, the wet flannel having been placed in the towel and covered by it, the rods are twisted until as much of the water as may be is squeezed out. The fomentation is then applied and covered by some heat-retaining material. Notwithstanding this covering, a fomentation will quickly cool, and therefore frequent repetition is necessary. The skin thus acted upon will be left in a reddened condition, and, to prevent the subsequent danger from cooling, must be wiped dry and sufficiently protected. To add to the activity of the fomentation a few drops of oil of turpentine may be sprinkled upon the flannel just previous to its application. Indeed, it is recommended by some that the flannel, when dipped in hot water and wrung out, shall be dipped into warm turpentine oil, again wrung out, and applied, but this generosity in turpentine will be objectionable in the larger number of cases because of the highly irritating character of that drug. The fomentation with oil of turpentine is commonly referred to as the "turpentine stupe."

The therapeutical uses of fomentations are in general those of poultices, because both these remedial agents act by virtue of heat and moisture alone. Fomentations, however, are far briefer in action than poultices; while a well-made and well-protected poultice may be serviceable for two hours and even longer, a fomentation equally well applied will be active no longer than a few minutes. Fomentations, consequently, are suited rather to those conditions where prompt action is required and where the impression need not be long maintained, and of such conditions the several varieties of *colic* are examples. In some cases, especially of abdominal disorder, the weight of a poultice is an objection to its use, and then fomentations become desirable. (See STUPES.)

HENRY A. GRIFFIN.

FOODS.—Food is a mixture of various organic and inorganic principles. The chief inorganic proximate principles are water and certain metallic salts, the most important of which is sodium chloride. The organic principles are three in number, classified, according to their chemical composition, as proteids, fats, and carbohydrates. The proteids are those foods in which nitrogen is the most prominent element, and include albumin, fibrin, and globulin. The fats, or hydrocarbons, are derived from both the animal and vegetable kingdoms. In these foods carbon is the most important element. In the carbohydrates carbon is again the important element. It is combined with oxygen and hydrogen in the proportion to form water. This group includes the sugars and starches. The teaching of Liebig that the proteids are devoted in the body exclusively to flesh formation and the fats and starches to heat production is now known to be not wholly true. The heat value of proteids is equal to that of the carbohydrates and a little less than one half that of the fats. We do not obtain, however, from these elements their full heat-producing value, because of their important office of building up tissue and repairing waste, which utilizes a part of their potential heat-producing power. The fact remains that the proteids have some share in generating heat and producing muscular power. A diet of proteids alone may give rise to the storing up of fat.

It is evident that properly constituted food should contain a due proportion of each of these proximate principles. As this condition exists in but very few single foods, a mixed diet becomes necessary. No one food, in fact,

contains all the elements in the proper proportion for the adult. Milk, which is most nearly a perfect food, has too large a proportion of nitrogen for the carbon. In vegetable foods, as a rule, the carbohydrates predominate; in animal foods the fats and proteids. Although the proximate principles derived from vegetable and animal foods show chemically little or no difference, physiologically they act in a decidedly different manner. Animals have been found to thrive best on a diet in which the carbon is derived from both the fats and the carbohydrates. It is well known that starch from some plants is more readily digested than that from others. Proteids of animal origin are digested more quickly and completely than those from the vegetable kingdom. Animal fats are also digested more easily than vegetable fats. The latter are less digestible partly because of the cellulose covering, which is very insoluble. The large amount of starch contained in vegetables tends to produce acid fermentation. Animal food has a distinctly stimulating tendency, owing to crystalline nitrogenous bodies which are contained in the muscle serum. Beef-tea, as ordinarily made, contains these stimulating elements, but lacks almost completely the nourishing elements. Properly selected vegetable food undoubtedly contains all the proximate principles. The fact that certain individuals live in health without meat simply proves that vegetarianism can be tolerated. It does not prove that it is best.

The study of the accompanying tables will show that proteid is the most universal proximate principle. Nitrogenous matter is found in almost every class of foods. All vegetables contain it in considerable amounts. The leguminous vegetables contain more proteid than meat. This is important, and should not be forgotten in prescribing vegetable diet. Meat, however, contains no starch or sugar. In vegetables, although proteid is invariably present in greater or less quantity, the sugars and starches occur in amounts from three to five times greater.

Vegetable Foods.—The cereal grains are the most important and the most largely used of vegetable foods. Their chief food constituents are albumin, fat, starch, and sugar. In making meal and flour the outer husk, consisting chiefly of cellulose, is removed. This is the indigestible element, and occurs in largest amount in oats. Wheat is the most universally used of the cereals, corn being largely substituted in this country and rye and barley in Europe. Rice, while it contains more starch than any of the other cereals, contains the smallest amount of proteid and practically no fat. This starch is very digestible, boiled rice being digested in an hour. The nutritive value of rice is small, and it is not suitable as an exclusive article of diet. In countries where it is used largely it is combined with oil or proteid. Indian corn also contains a large amount of starch and considerable fat. It is somewhat more nutritious than rice, but requires rather more than three hours for digestion. Its use frequently causes diarrhœa and digestive disorders. To furnish a complete food, corn should be combined with an animal proteid and fat. Oatmeal is rich in fat, but contains less starch than the other grains. When not sufficiently cooked, it is irritating and frequently causes digestive disturbance. It can not be taken by some. Thorough and prolonged cooking largely removes these objectionable features. Children with whom oatmeal disagrees are frequently able to eat it without trouble when it is cooked for two hours. Arrowroot, tapioca, and sago are composed almost entirely of starch, without fat or proteid. They require from one to two hours for digestion. They are especially adapted to conditions of *weak digestion.*

Wheat bread is probably more largely used in this country than any other article of vegetable diet. White bread is made from flour from which the cellulose and part of the starch and sugar, and a large proportion of the gluten, have been removed. Brown bread and so-called Graham bread contain all the elements of wheat. They have been vaunted as greatly superior to white bread. In *constipation* they undoubtedly have a beneficial effect. It is extremely doubtful, however, whether their universal use is to be desired. In connection with white bread and other diet, they are certainly valuable food elements. Macaroni consists chiefly of gluten with a small proportion of starch and fat. When plainly cooked it is digestible and nutritious. With a large amount of butter and cheese, it is not suitable for invalids. White bread requires from three and a half to four hours for digestion. Brown bread requires a somewhat longer time. The composition of bread is shown by the following table:

	Proteids.	Fat.	Carbohydrates.	Ash.	Water.
Wheat bread.......	8·80	1·00	55·00	1·70	33·00
Rye bread.........	7·70	1·00	48·00	1·60	40·00

The following table, showing the food value of the cereals, is from Yeo, based upon Bauer:

	Proteids.	Fat.	Starch and sugar.	Cellulose.	Ash.	Water.
Wheat......	12·42	1·70	67·89	2·66	1·79	13·54
Rye	11·43	1·71	67·83	2·01	1·79	15·26
Barley......	11·16	2·12	65·51	4·80	2·63	13·78
Oats.........	11·73	6·04	55·43	10·83	3·05	12·72
Maize........	10·05	4·76	66·78	2·84	0·69	13·88
Rice.........	7·81	0·69	76·40	0·78	0·09	13·23

Buckwheat, though not belonging to the cereal family, is largely used in this country. Its composition is as follows: Proteids, 9·28; fat, 1·89; starch and sugar, 70·68.

The potato is more largely used than any other vegetable food except wheat. It varies greatly in its composition, but a large amount of starch is always present. It is readily digested, and yields a large proportion of vegetable acids. Owing to the ease with which it is preserved, it is more extensively used as a fresh vegetable than any other member of its class. The composition of the sweet potato is much the same as that of the

white, except that the proportion of sugar is almost three times as great and that of the starch is somewhat less. It is not so digestible as the ordinary potato and does not keep so well. Turnips, beets, carrots, and parsneps are much slower and more difficult of digestion than potatoes. They also possess far less nutritive value. The beet contains an unusual proportion of sugar, and is the most nutritious member of this group. The cabbage represents a large group of vegetables (the *Cruciferæ*). It possesses but little nutritive value, but has strong antiscorbutic properties, and is a valuable addition to the dietary. It is a notable fact that this group does not contain a single poisonous plant.

Leguminous plants furnish some of the most valuable of foods. Peas, beans, and lentils are the most important members of this group. They contain an enormous amount of nitrogenous matter—more than is found in any form of meat. Unlike the nitrogen of meat, it is combined with a large amount of starch. These plants are also rich in inorganic compounds, especially those of sulphur, phosphorus, sodium, potassium, calcium, and magnesium. They are the best substitutes in the vegetable kingdom for meat. It is to be noted that lentils are especially rich in proteid and starch. They are among the most valuable of vegetable foods, and are worthy of more general use. The nutritive value of these foods is not diminished by drying, but their digestibility is somewhat affected.

The edible fungi are highly nutritious and very digestible forms of food. In Poland and some parts of Russia they form an important part of the food of the common people. They are not difficult of cultivation, and can be produced with special facility in the United States. Fresh American mushrooms are, in fact, greatly superior to those imported from Europe. The prevalent idea that mushrooms are indigestible is erroneous and due to the fact that the rich dressings with which they are often served are difficult of digestion.

Although the fruits contain but little of nutritive value, they are important articles of diet owing to their antiscorbutic properties and the presence of vegetable acids. The banana is among the most nutritious of fruits, and is not indigestible. Its use is largely increasing in the United States, thirteen million bunches being imported annually. The following table shows the food value of various vegetable products:

	Proteids.	Fat.	Carbohydrates.	Ash.	Water.
Peas	22·63	1·72	57·69	2·65	14·31
Beans	23·12	2·28	57·47	3·53	13·60
Lentils	24·81	1·85	58·36	2·47	12·51
Potatoes	2·25	0·15	21·92	1·18	74·50
Turnips	1·20	....	7·20	0·60	91·00
Beets	1·50	....	10·50	4·50	83·50
Carrots	1·30	0·20	10·40	1·00	83·00
Parsneps	1·10	0·50	15·40	1·00	82·00
Cabbage	2·00	0·50	5·80	0·70	91·00
Apples	0·39	....	14·88	0·31	83·58
Grapes	0·59	....	29·92	0·53	78·18
Oranges	0·73	....	7·33	0·49	89·01
Bananas	4·85	0·53	19·69	0·97	79·36

Animal Foods.—Among the animal foods beef easily stands first, both in nutritive quality and in digestibility. It varies considerably in its composition, according to the age of the animal and the amount of fat. Lean meat loses in cooking about one third of its total weight and fat meat about one half. Beef requires, according to Beaumont, about three hours for its digestion.

The toughness of meat is due chiefly to the fibrous tissue and sarcolemma of the muscle fibres. Meat and game are less tough after being kept for several days, owing to the formation of lactic acid, which softens these fibrous elements.

Veal requires a greater length of time for digestion, and is less nutritious than beef. The best veal is the flesh of calves from six to ten weeks old; that of calves under three weeks old is not considered suitable for food, and its sale is prohibited in many places. It has a decidedly laxative effect.

Mutton is among the most readily digested of animal foods. Though rich in fat, it has less nutritive value than beef. It is repugnant to some people, and hence can not always be used in sickness.

Pork is richer in fat and poorer in proteid than beef or mutton, hence it is not so readily digested by weak stomachs. It is much used by labourers because of the amount of fat it contains, its force-producing quality, and the readiness with which it is cooked with vegetables. It yields such a small percentage of solids to water that it is never employed in making broths.

The fowls employed for food are either domestic or wild. The difference between the two results chiefly from the character of their food. Chicken and the domestic fowls contain more fat and the meat is lighter in colour, but in wild fowl the meat has a more decided flavour. Chicken is a very important article of diet for the sick. It is the most digestible of all fowls, turkey being the next in order of digestibility. Geese and ducks contain a very large amount of fat, with a much less proportion of proteid than chicken. Partridge and wild fowl contain but little fat, but a large amount of proteid.

The varieties of fish used as food are numerous and vary greatly in nutritive value. Fish contains much less fibrous element than meat does. Fresh fish digests readily, but salted fish digests with great difficulty and has but slight nutritive value. The commonly accepted idea that fish is especially rich in phosphorus is not substantiated by chemical analysis. Oysters are extremely digestible and have decided nutritive value. They are more digestible when raw than when cooked. Oyster broth is very easily digested and is an excellent article of diet for the sick. The same is true of clam broth.

Milk is probably the only article of food which alone will sustain life for long periods of time. As an exclusive article of diet, between 50 and 60 oz. a day are said to be required. Its digestibility is greatly augmented by peptonizing. Butter is one of the

most digestible forms of fat. The numerous imitations, especially oleomargarine, agree very closely in chemical composition, digestibility, and nutritive value with butter made from cow's milk. When they are properly made there is nothing deleterious in these substitutes, and they are much cheaper; but they should not, of course, be sold as genuine butter. Cheese is a very concentrated food containing, practically, all the constituents of milk except the salts and a part of the sugar. Differences in the various kinds of cheese depend chiefly upon the character of the milk and the form of fermentation which it undergoes. Cheese, when taken in reasonable quantities, is not for most people an indigestible article of food. In certain forms of indigestion it is not well tolerated, and should not be used.

Chittenden, in analyses of the various meat extracts, has shown that they have very little nutritive value as compared with fresh lean beef. In most of these extracts the fat is less than 1 per cent., while the total amount of proteid matter available as nutriment ranges far below 1 per cent. Some of them are, in fact, less nutritious than ordinary beef-tea. The following table, made up from various sources, shows the composition of the most commonly used articles of animal food:

	Proteids.	Fat.	Ash.	Water.
Average meat	17·51	13·16	3·77	65·56
Beef (lean)	19·30	3·60	5·10	72·00
Beef (fat)	14·80	29·80	4·40	51·00
Veal	16·50	15·80	4·70	63·00
Mutton (lean)	18·30	4·90	4·80	72·00
Mutton (fat)	12·40	31·10	3·50	53·00
Pork (fat)	9·80	48·00	2·30	39·00
Bacon	7·10	66·80	2·10	24·00
Smoked ham	25·50	36·50	10·00	28·00
Venison	19·24	1·30	4·83	74·63
Poultry	8·80	3·80	1·20	74·00
Liver	18·90	4·10	3·00	74·00
Tripe	13·20	16·40	2·40	68·00
Beef-tea	3·28	0·25	0·67	95·79
Average fish	16·98	6·20	1·25	75·57
Whitefish	18·10	2·90	1·90	78·00
Herring (salted)	14·00	14·00	10·00	62·00
Salmon	16·10	5·10	1·40	77·00
Eels	9·90	13·80	1·30	75·00
Oysters	14·01	1·51	4·09	80·39
Egg (entire)	14·00	10·50	1·50	74·00
White of egg	20·40	.....	1·60	78·00
Yolk of egg	16·00	30·70	1·30	52·00

The Preservation of Food.—During recent years the preservation of food by various means has grown to enormous proportions. Foods are canned in glass and in tin, being practically sterilized and excluded from the air. They are, as a rule, as nutritious as ordinary fresh food, and suffer little from the process. The evaporation of food may be accomplished in driers at a high degree of temperature. This method is used especially in the preparation of evaporated fruits. Evaporation may also be effected by exposing the food substance to a dry atmosphere at a low temperature. Meat powders are prepared in this way. Condensed milk and cream are sold in large quantities. Milk is rarely condensed to more than one third its natural bulk, though more condensation is alleged. Numerous extracts of beef are also prepared by this method. Foods are preserved also by the use of sugar, salt, and oil. Sugar is usually employed in the preservation of fruits, salt in the preservation of meats and fish, and oil in the preservation of fish. These processes do not reduce the nutritive value of the food, but frequently render it less digestible. Refrigerated foods are used in great quantities and are transported very widely. Butter, eggs, meats, fruits, and vegetables may be kept for months at a low temperature induced by artificial means. If the temperature is kept continuously low no deleterious changes occur. Changes of temperature which permit the food to partially decompose are dangerous.

FLOYD M. CRANDALL.

FORCED FEEDING.—See under ALIMENTATION and GAVAGE.

FORMALDEHYDE, *formic aldehyde*, CH_2O, is used in watery solution. A 40-per-cent. aqueous solution, known by the trade names of *formalin* and *formol*, has come into extensive use as a deodorizer and disinfectant, its efficiency having been found to be very great and its poisonous properties so moderate as to be readily manageable. The gas may be set free by heating the solution, and all micro-organisms are said to perish speedily in an atmosphere containing 2·5 per cent. of the gas. Formalin has been particularly recommended as a substitute for corrosive sublimate in surgery, being considered more powerful as a germicide and far less dangerous, at the same time that it does not injure instruments, fabrics, etc.

Dr. R. H. Cunningham, of the Physiological Department of Columbia College, New York (*N. Y. Med. Jour.*, April 20, 1895), advises that for the sterilization of instruments, the surgeon's hands, etc., formalin should be used in very diluted solutions, for, he says, if a concentrated solution is applied to the skin a peculiar necrosis occurs that is unaccompanied by the usual signs of inflammation.

Formalin, says Dr. Cunningham, possesses the property of uniting with gelatin and with albumin to form insoluble compounds, so that if a film of gelatin such as one gets on a photographic gelatin dry plate is immersed in a solution of formalin for some hours, it is impossible to dissolve the changed film, even with prolonged boiling in water. Dr. Cunningham has taken advantage of this fact in the sterilization of catgut. If, he says, commercial surgical catgut is wound not too tightly on a glass spool and soaked for two days in a mixture of absolute alcohol and ether (equal parts) to thoroughly remove the grease, then rinsed in alcohol for a few moments, and from this removed to a small jar that has a tightly fitting cover and which contains enough of a mixture of equal parts of formalin and alcohol to well submerge the catgut, after several days the catgut may be removed and the formalin washed out by soaking it several times in fresh alcohol, or, which he considers preferable, it may be transferred to normal saline solution and boiled for half an hour or more and then transferred to alcohol

and preserved in that as usual. When catgut has been treated with this alcohol-formalin mixture, says Dr. Cunningham, a very peculiar change as regards some of its properties will be found to have occurred. It does not become stiff or brittle, and even after boiling in water for some hours it practically loses none of its former strength, and it does not disintegrate in boiling water as is the case with catgut prepared by the methods generally in vogue. The fact that the catgut can be boiled without destroying it is very important for these three among other reasons, says Dr. Cunningham: It facilitates the complete removal of the irritating formalin from the catgut, as both formalin and alcohol are readily soluble in water; a more aseptic state of the gut is produced by the antiseptic properties of the formalin; and it becomes still more surely aseptic as well as non-irritating from boiling in normal saline solution into which the spool of catgut can be put just at the beginning of a surgical operation and in this way avoid bringing alcohol, oil of juniper, etc., in contact with delicate membranes and other tissues.

In the *Lancet* for July 20, 1895, there is a note to the effect that M. Bardet has recently undertaken a series of experiments in conjunction with M. Trillat which appear to show that formalin, when prepared in considerable quantity and disengaged in a room, or even in one of the rooms of a house where all the internal doors are open, is a perfectly safe and efficacious disinfectant. They found that by the use of an apparatus converting 1 litre of methyl alcohol into formol in an hour for six hours a set of rooms with a capacity of 300 cubic metres could be absolutely disinfected, and this without the slightest deleterious effect upon furniture or other articles contained in the rooms, a few hours' ventilation being sufficient to restore all the contents of the rooms to their original condition. The experiments were conducted by means of injecting animals with cultures obtained from pieces of woollen, cotton, or other fabric which had been previously impregnated with various forms of virus and then subjected to the action of formol after various periods.

Disinfection with nascent formaldehyde has been proposed (*Lancet*, Sept. 21, 1895), the gas being generated by the incomplete combustion of wood spirit in a lamp around the free part of the wick of which platinum wire is coiled. After the lamp has been lighted and the platinum heated the flame is blown out, but combustion still goes on in an incomplete degree and formaldehyde is evolved.

Gepner (*Ctrlbl. f. prakt. Aug.*, June, 1894) recommends the employment of formaldehyde in a solution of 1 to 2,000 or 1 to 1,000 for irrigating purposes during operations, and in all *acute conjunctival diseases.* It causes decided hyperæmia of the conjunctiva and considerable smarting, which, however, he says, last but a short time in healthy eyes. In inflamed conjunctivæ the secretion is decidedly diminished.

Largely diluted (1 part of a 10-per-cent. solution to 68 parts of water), formaldehyde has been found very useful in gynæcological practice, especially for *gonorrhœal* and *catarrhal affections of the vagina and the cervix uteri.*

M. Lamarque's experience with formalin (*Mercredi méd.*, Sept. 11, 1895) is related by him as follows: Twenty patients suffering with *blennorrhagic urethritis*, acute or chronic, *blennorrhagic cystitis*, and *tuberculous* and *purulent cystitis* from various causes, had been subjected to a treatment consisting in instillations or in irrigation. The solution employed for irrigation was in the proportion of 1 in 500; for the instillations a 10-per-cent. solution was used. In blennorrhagic urethritis, both acute and chronic, the results had been contradictory; in a few cases the discharge had been cured very rapidly, while in others there had been no amelioration. Furthermore, in certain subjects the treatment had had to be suspended on account of the very acute irritation caused by the topical application. In the anterior urethra the irrigations or instillations of formol had been found very painful and followed by an irritating reaction, generally rather intense. However, says M. Lamarque, some success was obtained by the employment of this drug. In one case especially, where instillations of nitrate of silver had failed, good results had followed the use of formol. The posterior urethra and the bladder, in blennorrhagic inflammation, appeared to tolerate formol much better, although the introduction of the drug was followed by a rather sharp pain, generally of short duration. Formol is especially indicated, he says, in *tuberculous cystitis;* in all cases where it had been tried there had been a great amelioration, whether the mode of treatment had consisted in instillations or in irrigation. The pain is rather sharp at first, but it lasts a few minutes only. Formol is sometimes much better tolerated than corrosive sublimate. The results obtained from the experiments with this drug were the rapid disappearance of blood in the urine, considerable mitigation of pain, and very notable diminution of the frequency of micturition.

Pottevin (*Ann. de derm. et de syph.*, July, 1894; *Brit. Med. Jour.* (*Epitome*), Dec. 29, 1894) has employed formaldehyde in the treatment of *ringworm* as follows: The hair having been cut short, and the scalp having been carefully cleansed with soap, a compress of cotton wool soaked in a 2-per-cent. solution of formaldehyde is applied to the diseased parts or, better still, over the whole scalp. The whole is then covered with a rubber cap or with a piece of oiled silk kept in place by a bandage. This compress is left on for twenty-four hours; then, after an interval of twenty-four hours, a fresh application is made in the same way, and so on. The use of the dressing is discontinued or it is applied weaker if there is any sign of irritation of the scalp. The 2-per-cent. solution is generally well borne, but occasionally it is necessary to use one of 1 per cent. The author has never been able, even in the case of patients who bear the ordinary application, to use a 3-per-cent. solution. The

treatment is in no way dangerous, he says, and he has been able to continue it for three months without causing any unpleasant symptoms. In almost all cases the remedy failed to effect a cure. (Cf. PARAFORM.)

FORMALIN.—See FORMALDEHYDE.

FORMANILIDE, $C_6H_5N(CHO)H$, or *phenyl formamide*, is produced by heating aniline with ethyl formate or with oxalic acid. It occurs in colourless acicular crystals or prisms which are easily soluble in water, alcohol, or ether.

It seems to depress the functions both of motor and of sensory nerve-trunks, and on an abraded surface it has an anæsthetic action. Bokai considered that its action on the vasomotors was superior to that of antipyrine.

Blum (*Münch. med. Woch.*, 1893, p. 601) found that it had mild antiseptic power. Preisach used it as an insufflation in the throat, and found that it caused anæsthesia that lasted from two to twelve hours, while there was a complete loss of reflex excitability. Meisels used 15 minims of a 3-per-cent. solution in the urethra and obtained local anæsthesia.

Like antipyrine, it is a hæmostatic when applied to a bleeding surface.

Administered internally, in doses of from 2 to 10 grains, it is an antipyretic and analgetic that is indicated wherever acetanilide or antipyrine is likely to be useful.

SAMUEL T. ARMSTRONG.

FORMIC-ACID COMPOUNDS.—*Sodium formate* has been used in the treatment of *laryngeal tuberculosis* and some other laryngeal affections. Dr. E. L. Shurly, of Detroit, says (in a letter to the editor of this work) that it may be used in solution as a spray in the proportion of from 5 to 20 grains to an ounce of glycerin and water or water alone. It may be used also as an insufflation mixed with a little starch, in the proportion of 8 parts of the former to 2 of the latter. It is not wise usually, says Dr. Shurly, to blow this powder upon any but *ulcerated surfaces*. He has also used, in advanced *tuberculous laryngitis*, a pigment as strong as 40 to 60 grains to the ounce. It has proved of great service, according to Dr. Shurly's observation, in the treatment of laryngeal tuberculosis and *laryngeal carcinoma*. He has used it also for antiseptic purposes by hypodermic injection. The largest quantity that he has given at a dose in this way has been 5 grains dissolved in distilled water.

FORMIC ALDEHYDE, FORMOL.—See FORMALDEHYDE.

FOXGLOVE.—See DIGITALIS.

FRANCISCEA.—See MANACA.

FRANGULA (U. S. Ph.), *rhamni frangulæ cortex* (Br. Ph.), *cortex frangulæ* (Ger. Ph.), is the bark of *Rhamnus Frangula*, the alder buckthorn, a large shrub growing in Europe and northern Asia. The bark of the young trunk and medium-sized branches only is employed, and is kept at least a year before being used. The dried bark has the appearance of small quills, which externally are grayish or brownish but internally are lighter brown or yellow. This bark has little or no odour and a sweetish and somewhat bitter taste.

Much uncertainty exists as to the active principle of frangula, both frangulin and emodin having received this credit. Frangulin, or rhamnoxanthin, $C_{20}H_{20}O_{10}$, is a glucoside which occurs in small yellow crystals which are insoluble in water and in alcohol, somewhat soluble in warm alcohol, and soluble in benzene and in oil of turpentine. It has no odour or taste. It appears under some circumstances to be converted into emodin, $C_{15}H_{10}O_5$, and according to some authorities the frangulin of the fresh bark is transformed by drying into emodin, which they maintain is the active principle of the dried bark, while others assert that the fresh bark contains little emodin and no frangulin. Emodin also occurs in rhubarb. Because of some constituent which is removed by drying, the fresh bark is an active gastric and intestinal irritant and from doses of sufficient size there result vomiting, purging, and abdominal pain. That these may be avoided the pharmacopœias require that the bark shall be gathered at least a year before it is used. The dried bark is a cathartic of considerable value, resembling senna in its action and causing at times some griping. This griping may easily be avoided, however, by combining the frangula with an aromatic. As a purgative frangula is said to be much used in Europe, but in the United States the bark of another buckthorn, *Rhamnus purshiana*, is far oftener employed, is known as *cascara sagrada*, and is probably active because of the same or similar constituents as those of the European buckthorn. No special indications pertain to frangula, and it is suitable for any *constipation* of moderate severity. It is not violent in action, and may be used for the debilitated and in pregnancy. Frangula is said to be somewhat diuretic as well as anthelminthic.

There are several preparations of frangula. The fluid extract, *extractum frangulæ fluidum* (U. S. Ph., Ger. Ph.), may be given in doses of from 10 to 20 minims. The dose of the liquid extract, *extractum rhamni frangulæ liquidum* (Br. Ph.), is from 1 to 4 fl. drachms. The extract of frangula, *extractum rhamni frangulæ* (Br. Ph.), is given in doses of from 15 to 60 grains. A decoction (1 to 16) has been employed in doses of ½ fl. oz., and an elixir also is prepared.—HENRY A. GRIFFIN.

FRICTION.—See under MASSAGE.

FRIGOTHERAPY.—M. Raoul Pictet (*Med. Week*, Dec. 7, 1894) has given this name to a method of treating *dyspepsia* by wrapping the patient in blankets and furs and then subjecting him to extreme cold (the account says from 100 to 110 centigrade degrees below the freezing point!) for a few minutes daily in a "frigorific well."

FUCHSINE, or *rosaniline hydrochloride*, or *roseine*, $C_{20}H_{19}N_3.HCl$, has been employed as a remedy for *albuminuria* in daily amounts of from ¾ to 6 grains, preferably in the form of pills. Fuchsine that is free from arsenic should alone be employed.

FULLER'S EARTH.—See under EARTHS.

FUMIGATION.—The most frequent use of fumigation as a remedial measure is for the administration of mercury in the treatment of *syphilis*. Though in vogue in early times, fumigation passed into disuse, to be revived by an English syphilologist, Mr. Langston Parker. His method of treatment combined the vapour of water with the fumes of the sublimed mercury, constituting a mercurial vapour bath. The methods in vogue to-day of administering mercury by fumigation are to place the patient affected with secondary syphilis in a small cabinet, or upon a chair surrounded by a rubber cloth or blanket that closely encircles the neck and falls in tent-like folds to the floor, encompassing the chair by a closed cavity; or to form a cradle from two wooden or iron rods, six feet long, that are connected at either extremities and centre by iron hoops forming a semicircle having a diameter of from sixteen to twenty inches; the patient, lying in bed, is covered by this cradle, which supports the bedding, forming a closed cavity; by means of an elbow of stovepipe at the foot of the bed, the vapour of mercury may be conveyed from a lamp into the cavity formed by the cradle and the bedclothes. The mercury vapour may be generated from metallic mercury, mercury with chalk, calomel, the binoxide, or the bisulphide. Pure calomel, resublimed in order to free it from impurities, is the most satisfactory preparation to use, from a scruple to 3 drachms sufficing for each bath. The mercurial preparation is placed upon a metal plate or porcelain cup which may rest upon a ring of a retort stand; a spirit or coal-oil lamp or Bunsen burner beneath the receptacle for the mercury will soon produce mercurial fumes in abundance, while the heat from the lamp causes free perspiration. Each bath should be continued for from fifteen to thirty minutes, when the flame of the heating apparatus may be discontinued and the patient allowed to cool for a few minutes and then put to bed. The best time to administer the baths is just before the patient goes to bed at night. His strength and general condition will indicate the frequency of their administration; in strong individuals with decided secondary symptoms a bath every night may be tolerated; usually, however, a bath every second or third night will suffice. Several convenient lamps have been invented which may be used to give mercurial baths, though the baths may be as effectively given with a home-made apparatus. The investigations of Keyes and the later ones of Schlesinger have shown the restorative action of mercury on the blood, and it might be advisable for the physician to examine the patient's blood from time to time with von Fleischl's hæmoglobinometer.

Objections have been urged against this method of treating syphilis that it sometimes causes headache and debility, and that the amount of the mercury that enters the system can not be accurately determined. There is no more uncertainty about the dose, however, than there is in the inunction treatment, the headache and debility are more likely to be the incidents of syphilis than of the treatment, and the hæmometric tests will indicate the range of improvement and, *pari passu*, the required frequency of the baths.

Another useful application of mercurial fumigation is in the treatment of *laryngeal diphtheria* or *croup*. The child should be put into a bed or crib that is so arranged that a blanket or piece of canvas will form an inclosed space. The calomel fumes may be introduced into this by means of a stovepipe, or the mercury may be sublimed within the space of the crib itself. The dyspnœa is usually relieved, there may be some specific action of the mercury on the disease process itself, and the mercury that is absorbed is likely to favour hæmatogenesis.

Sulphur fumigations have had more or less popularity in the treatment of certain *chronic skin diseases* for a number of years. The patient's body is inclosed in a cabinet or box that allows him to sit on a stool while his head protrudes from an aperture that is tightly closed about his neck by means of sheets and towels. The sulphur is burned by means of a lamp, and the heat produced within the cabinet soon causes free perspiration. These sulphur fumigations will quickly cure *scabies;* they are useful in *eczema* and in several of the vesicular or pustular skin diseases, in *muscular rheumatism*, and in some *neuralgias*, including *sciatica*.

Fumigation is usually applied to the mucous membranes of the respiratory tract by means of cigarettes, or by smoking a drug in a pipe. For *acute coryza*, *subacute bronchitis*, or *bronchial catarrh*, cigarettes made of powdered cubeb or that drug smoked in a pipe will afford prompt relief to the symptoms.

Fumigation by smoking powdered stramonium, originally practised in the East Indies, is of benefit for the paroxysms of *spasmodic asthma*. The leaves and root of *Datura stramonium* may be smoked, and the smoke produces a sensation of warmth in the lungs that is succeeded by copious expectoration. If too large a quantity is smoked, vertigo and nausea may result.

Professor H. C. Wood has published the formula of an arsenical paper cigarette that is dispensed in the Philadelphia Hospital under the title of compound arsenical paper, *charta arsenicalis composita*.

SAMUEL T. ARMSTRONG.

GALACTAGOGUES.—The various drugs reputed to possess the power of stimulating the milk secretion are of little or no practical value for the purpose. Very few of them exert any appreciable influence upon the mammary function, and these only for a time. The principal agents of this class are anise, vanilla, dill, fennel, beer or ale, sinapisms, galega, the leaves of the castor-oil plant, calabar bean, jaborandi, and strychnine. The first four named, it is maintained, may act by imparting an agreeable flavour to the milk. The child is thus induced to nurse more vigorously, and the reflex stimulus from the nipple increases

the flow of the milk. However this may be, these drugs exert no direct effect on the mammary secretion.

Beer, ale, and porter hold a somewhat prominent place in both popular and professional favour as remedial agents in *deficient lactation.* If they have any influence at all upon the milk secretion it is probably to increase the quantity at the expense of the quality, and even this effect is at most only temporary. As a rule, a nursing mother will best serve the interests of her own health and that of her child by abstaining from alcoholic drinks. Three or four drachms of malt with each meal would doubtless be found of more benefit than beer, and without its objectionable effects.

The topical use of weak mustard poultices may possibly exert some influence upon the quantity of milk secreted by determining more blood to the breast.

Galega (*q. v.*) is recommended by numerous authorities for its galactagogue properties. The aqueous extract is said to be the best preparation.

The castor-oil plant has long had a popular reputation as a galactagogue. The moistened leaves are applied to the breast as a poultice. The oil, too, is sometimes used locally, and a fluid extract of the leaves has been given internally as a remedy in *agalactia.* The efficacy of the castor-oil plant and its preparations as a mammary stimulant, however, is more than doubtful.

Calabar bean and its preparations are credited with galactagogue properties. Of the powdered bean the dose is 1 grain, gradually increased; of the tincture, 12 minims are given three times daily; of the extract, the dose for the purpose is from $\frac{1}{16}$ to $\frac{1}{4}$ of a grain at similar intervals. The drug, however, is of little real value for promoting the secretion of milk.

Probably no medicinal agent is more nearly entitled to be ranked as a galactagogue than jaborandi. Either the infusion ($\frac{1}{2}$ fl. oz.), the fluid extract ($\frac{1}{2}$ fl. drachm), the tincture ($\frac{1}{2}$ fl. drachm), or pilocarpine nitrate ($\frac{1}{6}$ of a grain) may be used. The latter agent may be given hypodermically. The preparations of jaborandi, however, soon lose their effect upon the milk glands. The excessive perspiration and salivation which attend their use are also objections to their employment.

Strychnine has been recommended to increase the secretion of milk in nursing women. The writer has given the sulphate in doses of $\frac{1}{40}$ of a grain three times daily with apparent benefit, but its galactopoietic influence is doubtless to be explained by its general tonic effect.

Weak galvanic currents (from 5 to 10 milliampères) and mild faradization, it is alleged, are of some value as means of stimulating the mammary function. The current is applied directly through the breasts for about five minutes once or twice daily. The contention seems reasonable in theory, and prompt and satisfactory results have been reported by numerous observers.

The most rational method of maintaining a normal supply of milk is by attention to the nutrition and general health and habits of the mother. A strict observance of the ordinary rules of hygiene is essential. Hæmorrhage and other vital losses must be prevented. General tonics, and especially iron, are indicated for the majority of convalescents from labour. The diet should be as generous as the patient can digest. There is little to be gained by the common practice of prescribing two or three extra meals daily. The milk supply as well as the general health of the woman will depend more upon what she digests and assimilates than upon the amount of food taken into the stomach. Three daily meals, with at most a single liquid meal at bedtime, will generally be better than five or six. Milk should constitute a portion of the dietary. The difficulty in digesting milk of which many patients complain is for the most part imaginary. If taken as a part of the meal and not in addition to it, it will, as a rule, be well borne. Frequently patients who can not use cold milk can take it hot without difficulty. A little salt aids its digestion and often makes it more acceptable to the palate.

The secretion of milk is said to be greatly diminished by fatty food. A vegetable diet reduces the proportion of butter and casein and increases the sugar. A meat diet has the opposite effect. Systematic nursing with strict observance of stated intervals is essential for its influence upon both the quantity and quality of the milk secretion. Freedom from depressing emotions and injurious mental excitement is especially important.

CHARLES JEWETT.

GALANGAL, *rhizoma galangæ* (Ger. Ph.), is the dried root of the zingiberaceous plant *Alpinia officinarum.* It is aromatic and gently stimulating. The dose is from 10 to 30 grains.

GALAZYME.—This is a substitute for kumyss suggested by Dujardin-Beaumetz, made by fermenting cow's milk with brewers' yeast, a little sugar being added.

GALBANUM (Br. Ph., Ger. Ph.) is a gum resin obtained from the *Ferula galbaniflua* and other species of Persian plants. It has a peculiar, characteristic odour, and a pungent, acrid taste. It is soluble in alcohol, even when the latter is diluted. The resin contains sulphur, and is soluble in ether and in alkaline liquids; when fused with caustic potash it produces resorcin, and when heated with hydrochloric acid it produces umbelliferene, $C_9H_6O_3$, which occurs in colourless acicular crystals that have no known therapeutic property.

Externally, galbanum is a stimulant, and once had great vogue as an application to indolent swellings, such as the chronic scrofulous enlargement of glands and joints. Galbanum plaster, *emplastrum galbani,* was formerly official in the U. S. Ph., and is still retained in the Br. Ph., which directs that it be prepared by mixing and straining 1 oz. each of galbanum and ammoniacum, and adding the product to a mixture of 1 oz. of yellow wax and 8 oz. of lead plaster.

Internally, galbanum was used as an expectorant and antispasmodic, in the treatment of *chronic bronchitis*, also in that of *hysteria* and other neuroses. It was said to be useful in the treatment of *chronic rheumatism*, *chlorosis*, and *amenorrhœa*. For the latter conditions the compound galbanum pills, *pilulæ galbani compositæ*, formerly official in the U. S. Ph., were administered. Each pill contained 1½ grain each of myrrh and galbanum and ½ a grain of asafœtida. From two to four were given at a dose.

The feeble therapeutic properties of galbanum have resulted in its comparative disuse. Internally, it may be administered in doses of from 10 to 20 grains.

SAMUEL T. ARMSTRONG.

GALEGA.—The leaves of *Galega officinalis*, a papilionaceous plant formerly used in medicine, have been brought into use anew by Carron (*Rev. gén. de clin. et de thérap.*, 1891, No. 28, cited in Eulenburg's *Encycl. Jahrb. d. ges. Heilk.*, 1892) as a galactagogue. M. Bocquillon-Limousin says that galega possesses incontestable galactagogue properties. Such a statement, pending convincing clinical reports, must be taken with reserve, however. The daily amount to be employed is 40 grains of the dried leaves; that of a non-official aqueous extract is from 7 to 10 grains.

GALIUM.—The flowering tops of *Galium mollugo* and *Galium verum*, rubiaceous plants, have been considered antispasmodic.

GALLA.—See GALLS.

GALLACETOPHENONE, or *trioxybenzol*, $CH_3CO.C_6H_2(OH)_3$, a variety of alizarine-yellow dye, has been used as an external application, in a 10-per-cent. solution or ointment, in *psoriasis*. It is thought to be somewhat inferior to chrysarobin as a remedy for that disease, and it is expensive, but it has the advantage of not staining the linen.

GALLAL, or *aluminum and ammonium gallate*, is a mild astringent.

GALLANILIDE, GALLANOL, $C_{13}H_{13}NO_3$, obtained by heating gallotannic acid with an excess of aniline, is a white crystalline substance readily soluble in boiling water, but almost insoluble in cold water. It is used topically in powder, in an ointment of from 10 to 25 per cent., and in an alcoholic solution of 10 per cent. as a resolvent in *chronic eczema* with infiltration, also in *psoriasis*.

GALLIC ACID, *acidum gallicum* (U. S. Ph., Br. Ph.), is an organic acid prepared from tannic acid or from galls. Its formula is $HC_7H_5O_5+H_2O$. If galls in infusion or in moistened powder are exposed to the air there results a conversion of their tannic acid into gallic acid. This action is the basis of a mode of preparing gallic acid, but the process recommended by the Br. Ph. is to be preferred because of the smaller amount of time required. According to this process 1 part of coarsely powdered galls is boiled with 4 parts of diluted sulphuric acid for half an hour; the fluid is strained through calico while hot; the crystals which are deposited when this is cooled are collected and purified with animal charcoal and by repeated crystallization. When pure, the acid occurs in white or pale fawn-coloured crystals which are odourless, permanent in the air, and of an astringent and somewhat acid taste. The drug is soluble at 59° F. in 100 parts of water, in 5 parts of alcohol, in 3 parts of boiling water, and in 1 part of boiling alcohol. With ferric salts gallic acid forms a bluish-black precipitate, but on pure ferrous salts it has no effect. Unlike tannic acid, its aqueous solution will not precipitate alkaloids, gelatin, albumin, or starch test solution. If heated to 420° F., gallic acid parts with carbon dioxide and pyrogallic acid is formed.

Since gallic acid does not coagulate albumin, its action, when locally applied, though astringent, is considerably less so than that of tannic acid. Given by the mouth, it is rapidly absorbed from the stomach, circulates unchanged in the blood, and exerts an astringent effect upon remote portions of the body. As tannic acid is a coagulator of albumin and is only absorbable after its conversion into gallic acid, it is obviously advantageous to administer gallic acid for hæmorrhages and *exudations* which can not be reached except through the circulation, while it is equally evident that in cases where an astringent can be directly applied tannic acid is by far the more potent drug. Gallic acid is eliminated by the kidneys and mainly unaltered.

The therapeutics of gallic acid is as an astringent and mainly for remote effect. It may thus be valuable in *hæmoptysis*, sometimes in *metrorrhagia*, and especially in *hæmaturia*. Its astringent power is sometimes favourably exerted in *colliquative sweating*, *bronchorrhœa*, and *diabetes insipidus*. It is thought to diminish exudation from the renal vessels in *albuminuria* and in *acute nephritis*. For its effect on the intestines gallic acid may be beneficial, but is certainly less potent than tannic acid. It has been recommended for *hæmophilia*. Though less astringent than tannic acid when locally used, gallic acid may be applied to diminish the discharges from *ulcers* and the *relaxation of mucous surfaces*.

Gallic acid may be given in powder or in pill. The dose is from 2 to 10 grains. Glycerin of gallic acid, *glycerinum acidi gallici* (Br. Ph.), contains 1 part in 6 by weight. Ointment of gallic acid, *unguentum acidi gallici* (U. S. Ph. 1880), contained 10 parts of the acid to 90 parts of benzoinated lard. It is no longer official.—HENRY A. GRIFFIN.

GALLICIN, or *methyl ether of gallic acid*, is prepared by heating a solution of gallic or tannic acid in methyl alcohol in the presence of hydrochloric-acid gas or strong sulphuric acid. The rhombic prisms which form are dissolved in hot water, and as the water cools gallicin is precipitated in fine snow-white needles. Mellinger (*Corresp.-Bl. f. Schweizer Aerzte*, 1895, No. 8; *Med. News*, May 11, 1895) has used gallicin in various forms of catarrhal and phlyctænular *conjunctivitis* and in superficial *keratitis* with good results. The cases of conjunctivitis in which he found it most

serviceable were those of the catarrhal kind, especially those attended with chronic swelling of the conjunctiva and a slight or viscid secretion, together with an eczematous condition of the margins of the lids. He used it in the form of powder dusted on to the affected surface once or twice a day. In some cases the application was followed by a feeling of burning, which was allayed with cold affusions. It was found that the burning sensation could be prevented by the previous instillation of a 2-per-cent. solution of cocaine.

GALLOBROMOL, or *dibromogallic acid*, $C_6Br_2(OH)_3.COOH$, is a bromine substitution compound of gallic acid. It crystallizes in fine white needles readily soluble in alcohol, ether, or boiling water, but sparingly soluble in cold water. The compound appears to have the astringent, antiseptic, and nervous sedative properties of its constituents. Solutions of 1 or 2 per cent. have been found efficient as an injection in *gonorrhœa*, especially for the relief of *chordee*. Letzel (*Aerztl. Rundschau*, 1894, No. 13; *Dtsch. med.-Ztg.*, Feb. 21, 1895) has used such solutions, applied on compresses, successfully in a few cases of *acute eczema*. Given internally, in daily amounts of from 7 to 150 grains, it has been found useful in *epilepsy*, but, on the whole, rather less efficient than the bromides; in *chorea*, on the other hand, it has been found more effective.

GALLOL.—See Gallanol.

GALLS, *galla* (U. S. Ph., Br. Ph.), *gallæ* (Ger. Ph.), are excrescences formed on *Quercus lusitanica* in consequence of its being punctured by *Cynips gallæ tinctoriæ* and the insect's egg deposited in it. Galls are astringent and slightly tonic. They are now little used in medicine, but furnish gallic and tannic acids. The powder may be given in doses of from 5 to 30 grains. The dose of the tincture, *tinctura gallæ* (U. S. Ph., Br. Ph.), *tinctura gallarum* (Ger. Ph.), is from ½ to 2 fl. drachms. Galls are used chiefly in *chronic diarrhœa*. Nutgalls, given in powder, tincture, or infusion, are serviceable in cases of *poisoning with an alkaloid* (see page 109), and may be used if tannic acid is not at hand. Nutgall ointment, *unguentum gallæ* (U. S. Ph., Br. Ph.), may be employed as an astringent application. The *unguentum gallæ cum opio* of the Br. Ph., each ounce of which contains 32 grains of powdered opium, is applied for the relief of painful *hæmorrhoids*.

GALVANISM.—See Electricity.

GAMBOGE, *cambogia* (U. S. Ph., Br. Ph.), *gutti* (Ger. Ph.), is the inspissated juice of several species of *Garcinia*, a plant native to eastern Asia. Internally it is a powerful hydragogue cathartic, and externally it is irritant and stimulating to raw surfaces. In doses of from 3 to 4 grains it produces several liquid evacuations, accompanied by little pain. Combined with calomel, it is very efficient in relieving *malarial congestion of the liver*. As it is tasteless, it is very often given to children after the administration of an anthelminthic. In doses of $\frac{1}{6}$ of a grain, dissolved in a weak

solution of potassium carbonate, it is decidedly diuretic. For the relief of *engorgement of the portal circulation*, equal parts of gamboge and aloes are extremely useful. Gamboge is oftener used in combination than alone, and, as a rule, if it is used separately, it is best administered in syrup. In doses of from $\frac{1}{16}$ to $\frac{1}{4}$ of a grain, three times daily, it very often relieves *flatulence* and *intestinal indigestion*. It enters into the composition of the compound cathartic pills of the U. S. Ph., and, with equal parts of aloes, forms the compound gamboge pill, *pilula cambogiæ composita*, of the Br. Ph. The dose of this pill mass is from 5 to 10 grains.

Russell H. Nevins.

GARGLES, *gargarismata*, are liquid preparations, usually mixtures, often viscid, which are intended to be held for a time in the throat during incomplete glutitory efforts, for local medication of the tonsils, palate, pharynx, base of the tongue, epiglottis, and arytænoid eminences. Although often misapplied, and for that reason in disfavour with many physicians, they have a veritable, if limited, usefulness. They are to be preferred to sprays and direct topical applications where it seems desirable to bathe the affected parts with some quantity of the medicament, and to prolong the contact. In some cases, too, both with children and with adults, opposition is made to the use of sprays or to topical applications, but the patient shows willingness to gargle. With a little patience very young children may be taught to gargle efficiently. Gargles, moreover, will reach out-of-the-way corners of the throat much better than sprays as applied by the ordinary patient or nurse.

The following pertinent remarks concerning *gargling* may be quoted from J. Solis-Cohen (*Diseases of the Throat and Nasal Passages*, New York, 1879, p. 95):

"The usual method of retaining a quantity of fluid in the mouth, and keeping it in motion between the base of the tongue and palate by repeatedly forcing an expiratory current of air through it, while the base of the tongue is elevated so as nearly to touch the palate, is not only a painful muscular exercise in severe sore throat, but is inefficient in bringing the fluid in contact with anything else than the palate and root of the tongue. In order to reach the pharynx the fluid must be submitted to the action of the constrictor muscles, but be released before completing the last phase of the act of deglutition—a partial act of swallowing being made, therefore, and frequently repeated—a practice which is often difficult to acquire, and which is also painful in sore throat. A much better and less painful procedure is to bring the fluid in contact with the sore parts by letting it flow upon them by gravity as the head is turned to one side, backward or forward, as the case may be, so as to wash the various portions of the surface in succession. Another method well adapted for bringing the fluid in contact with the epiglottis, the walls of the pharyngo-laryngeal sinuses, the upper and posterior surface of the larynx, and the lower part of the pharynx, is to carry

the fluid in a spoon back to the base of the tongue, and then pour it over the parts as the head is thrown back, which will bring it in contact with the epiglottis and the upper and posterior surfaces of the larynx, and then by holding the head sidewise, it is brought in contact with the lateral walls of the lower pharynx and the surfaces of the pharyngo-laryngeal sinuses, the operation being completed by suddenly bringing the head forward as the fluid is ejected, so as to bathe the posterior surface of the middle portion of the pharynx, the anterior surface of the palate, and the exposed surface of the tonsils and palatine folds."

The solutions used for gargling may also be applied topically by means of a brush, sponge, or cotton wad.

Gargles may be cleansing (or detergent), antiseptic, solvent, astringent, cooling, stimulating, emollient, sedative, or specific. Usually one mixture is designed to fulfil several indications. The principal components of a gargling mixture are the astringent, sedative, or antiseptic drug, a solvent, a flavouring agent, and a modicum of mucilage, glycerin, or other viscid substance to hold the mixture in contact with the parts as long as possible.

As a *cleansing gargle*, simple water, or water slightly aromatized with a few drops of cologne or of some essential oil, is usually sufficient. It may be hot, lukewarm, or cold, as is most agreeable. When there is considerable mucus, especially if it is thick and tenacious, sodium phosphate or sodium bicarbonate may be dissolved in the water in the proportion of 4 grains to the ounce, or a few drops of tincture of quillaia, or of the detergent emulsion of coal-tar and soap-bark, may be added. Solution of *hydrogen dioxide*, diluted to about "three volumes" strength (1 in 3 or 4 of the recent official solution), may be used as a cleansing gargle, but its chief field of usefulness is as an *antiseptic*, for which purpose it is the best of all agents, unless the new preparation of chlorine and hypochlorites—known as *electrozone*, and made by electrolysing sea-water—shall prove its equal. Many of the commercial preparations of H_2O_2—and some of the best advertised are the worst—are too acid to be employed with safety. Care must be taken. Liquor sodæ chlorinatæ fl ʒ j to fl ℥ iv; potassium chlorate, gr. xx to fl ℥ j; potassium chloride, gr. xx to fl ℥ j; *carbolic acid* (or guaiacol), gr. v to fl ℥ j; mistura oleoso-balsamica, fl ʒ j to fl ℥ iv (this mixture is the old and well-known *elixir vitæ* of Hoffman, which is poorly imitated in the proprietary preparation known as "Listerine"); eucalyptol, thymol, menthol, sodium benzoate, *benzoic acid*, gr. v to fl ℥ j; sodium borate, gr. v to fl ℥ j; boric acid (saturated solution), or preferably boroglyceride—are among the most useful ingredients for antiseptic gargles, and may be variously combined, an alkaline salt, a chlorine preparation, a tar-product, and a balsamic or an essential oil forming a very excellent combination. Glycerin or refined honey (fl ʒ j to fl ℥ j) may be employed to give the preparation body and consistence, and to favour the prolonged contact of the agent with the parts, after the application. Potassium permanganate, gr. viij to fl ℥ j, may be employed. It should not be combined with other agents, and has the disadvantage of leaving disagreeable stains. Therapeutically it is quite efficient. The writer does not favour the use of solution of mercuric chloride as a gargle.

As *solvents of false membrane*, solution of hydrogen dioxide (official strength or diluted one half), and preparations containing the digestive ferments, preferably trypsin or papayotin, may be employed.

As *astringents*, glycerole of tannin and alum or zinc sulphocarbolate (5 grains to the ounce of rose water) are applicable. Hot water is often useful in the early stages of inflammation. Ice or cold water is usually more agreeable later. Barley water, flaxseed tea, and mucilage of acacia are employed as *emollients*. The addition of anodyne drugs, such as opium, hyoscyamus, cocaine, and the like to gargles is dangerous, as too great a dose might by accident be swallowed. A grain of menthol dissolved in glycerin or oil, or a drop or two of peppermint oil, often serves a useful purpose as a *sedative*.

As *specifics*, potassium chlorate (originally, through an error in translation, by which *kalium chloricum* of the Germans was so rendered, instead of as potassium chloride), potassium iodide, mercuric chloride, and guaiac have been used. Potassium chlorate is sometimes simply dissolved in water, and at other times variously compounded. Its greatest usefulness is in the treatment of *mercurial stomatitis*. It is frequently mixed with tincture of ferric chloride in the treatment of diphtheria, glycerin being the menstruum. The following mixture has much vogue and is often useful in the treatment of *acute amygdalitis:* Ammoniated tincture of guaiac, 3 fl. drachms; compound tincture of cinchona, 4 fl. drachms; refined honey, 6 fl. drachms. Mix and shake until the sides of the containing vessel are well coated. Add slowly potassium chlorate, 80 grains, dissolved in water enough to make 4 fl. oz. Sodium salicylate may sometimes be substituted for the potassium chlorate, and no doubt potassium chloride would always be preferable. Since the introduction of guaiacol as a topical application in cases of amygdalitis this gargle may be, in the majority of cases, dispensed with.—Solomon Solis-Cohen.

GARLIC, the *allium* of the U. S. Ph., is a stimulant to *gastric digestion*, and is sometimes employed, like the onion, as a *rubefacient*. A syrup, *syrupus allii*, is official in the U. S. Ph.

GAULTHERIA, popularly known as wintergreen, partridge berry, boxberry, checkerberry, deerberry, teaberry, and mountain tea, is a small shrub-like evergreen plant that is indigenous to the woods of North America from Canada to the Carolinas. The leaves alone are official. From the leaves a volatile oil, *oleum gaultheriæ* (U. S. Ph.), arbutin, ericolin, ursone, and tannic acid have been obtained. The leaves have an agreeable, aromatic, slightly bitter, and astringent taste. The

aromatic and medicinal properties of the leaves are contained in the oil, which may be obtained from all parts of the plant.

Oil of gaultheria, commonly referred to as oil of wintergreen, is a very volatile, slightly straw-coloured liquid, that becomes darker when exposed to the air. It has a characteristic penetrating odour, a sweetish, pungent taste, and a slightly acid reaction. While it is chemically almost identical with the oil of sweet birch, and the latter is often substituted for it, the refractometer will establish the difference between these oils. It has been found that 10 per cent. of the oil consists of *gaultherilene*, a hydrocarbon, and 90 per cent. of methyl salicylate, $CH_3C_7H_5O_3$, a substitution compound in which one of the hydrogen atoms of salicylic acid has been replaced by a methyl molecule.

Dr. H. C. Wood and Dr. Hobart A. Hare showed in 1886 that the physiological action of oil of gaultheria was the same as that of salicylic acid, and that in therapeutic doses the oil was entirely decomposed in the system, although, if it was administered in toxic amounts, it might escape in part unchanged.

An infusion of the leaves is used in some rural localities as an *emmenagogue* and as a *galactagogue*, but there is no characteristic action of the leaves in these disorders. More useful is the administration of a decoction in *gastro-enteritis*, the tannin of the leaves acting as an astringent and the oil as an intestinal antiseptic.

The oil is an *antiseptic*, *antipyretic*, and *antirrheumatic*. It may be applied externally in a liniment, or given internally, or the two methods may be combined, in the treatment of *acute articular rheumatism*. The dose should be from 5 to 15 minims, repeated as may be necessary according to the age and condition of the patient; H. C. Wood has stated that he has given as much as 150 drops in twenty-four hours. It must not be forgotten that the oil is toxic in large amounts, and while there are instances on record in which individuals have recovered after taking from ½ to 1 fl. oz., fatal results have followed the administration of the latter quantity. The oil is best given in emulsion or in capsules; it is more likely to cause gastric distress than salicylic acid made from oil of wintergreen. Spirit of gaultheria, *spiritus gaultheriæ* (U. S. Ph.), is a solution of 1 part of the oil in 20 parts of alcohol.—Samuel T. Armstrong.

GAVAGE.—This term was introduced by French writers to designate forced feeding, especially the introduction of food into the stomach through an œsophageal tube. The procedure is based upon the accidental discovery that in cases of intractable vomiting, food so introduced is often retained and digested. The explanation is not very plain, but it has been suggested that by gavage prolonged and repeated irritation of the vagus and sympathetic during sucking and swallowing is avoided; that no residue of decomposable material is left in the mouth to irritate the gustatory and olfactory nerves; and that the repeated mechanical irritation of the stomach by the entrance of food with each act of swallowing is absent. Gavage also eliminates to a large extent the mental repugnance to food and to eating, which is often an important factor in the class of cases in which it is applicable. It has been observed that digestive power is not always proportionate to appetite, and that the tube can be used in wasting diseases, like *phthisis*, to introduce a larger supply of food than the patient could be induced to swallow.

The apparatus required is the same as that for stomach washing—namely, a siphon, consisting of a flexible rubber œsophageal tube, with fairly thick walls, and about two feet long, joined by a few inches of glass tubing to a yard or less of ordinary rubber tubing, into the end of which a glass funnel is inserted. The œsophageal tube should be about No. 20, American gauge, or ⅜ of an inch outside diameter for an adult. It is most easily introduced while the patient is seated, and the head is not thrown back; the tongue should be slightly protruded and the patient directed to breathe slowly and deeply, and not to be alarmed. The tube, having been properly cleansed and well moistened, is passed along the median line to the base of the tongue; on reaching the posterior wall of the pharynx the tip bends downward and naturally seeks the œsophageal opening; it is not necessary to insert the finger into the patient's mouth as a guide. Having reached this point, the patient is directed to swallow, and while this is done the tube is quickly passed into the stomach. After a few trials the whole operation can usually be done very quickly and with little disturbance. After the tube is in position, the funnel with the tubing attached should be raised to allow the escape of gas, and if desirable the stomach may be washed by pouring tepid water into the funnel, while the latter is raised slightly above the level of the stomach. Before the funnel has entirely emptied itself, if it be quickly depressed below the level of the stomach, the fluid will be siphoned out, and the process may be continued until the wash water returns clear.

It is usually well to previously wash the stomach at least once a day when using gavage. Warm milk, plain or peptonized, broths or thin gruels, may be introduced in considerable amounts several times a day. When the tube is withdrawn it should be pinched to prevent trickling into the fauces.

Debove has used gavage with benefit in *phthisis*, in which, as he observes, more food is required than in health, on account of the increased bodily waste. He states that "a patient who has no appetite, or who has a marked disgust for all food, will digest perfectly a large meal introduced by the tube, and even at the end of a certain time will recover appetite." At the same time oxygen must be furnished in increased amounts by an out-of-door life, or the imperfectly oxidized products of digestion will add to the toxæmia of the patient.

The principle of overfeeding may be applied by the use of raw, dried meat powder, which

may be given in soup, milk, or punch, and the use of the tube in *phthisis* reserved for the cases with specially *irritable stomachs.*

It is in cases of the neurotic type that gavage finds its most useful application, especially in those characterized by *vomiting*, severe *anorexia, spasm of the œsophagus*, or *wasting*. The systematic use of the tube will sometimes prove of the greatest value in such cases. It should not be forgotten, however, that feeding without the tube can often be accomplished in difficult cases by carrying the fluid in a spoon so far back into the pharynx that it is beyond the control of the patient, and is carried into the pharynx by reflex action.

In certain *chronic disorders of the stomach* gavage may be advantageously combined with lavage.

After an experience with over 400 cases in hospital and private practice, Dr. L. Emmett Holt regards gavage as of great value in many of the diseases of infancy. The procedure is simple, taking less than half a minute, and seldom causes vomiting. The baby is laid flat on its back and its head is steadied by an assistant, while the soft-rubber catheter—No. 14, American scale, for infants under six months, No. 17 for older babies—is introduced along the forefinger. In all but very young infants a gag is required. The tube may also be passed through the nose, but this is rarely necessary. The indications for gavage in infants are:

1. For *infants prematurely born*, in connection with the incubator. By the use of these means the mortality in premature infants at the Paris Maternity has been very considerably reduced.

2. For *persistent vomiting* due partly to habit, partly to exaggerated pharyngeal reflex action.

3. In acute diseases, such as severe cases of *scarlet fever, diphtheria, broncho-pneumonia, typhoid fever*, and *empyema*, when food is refused. This often happens in children from two to five years of age, after four or five days of severe sickness, and gavage is both more efficient and less distressing than forcing the child to swallow by holding the nose.

4. In serious *brain disease*, when the patient can not be fed by ordinary means.

Henry Ling Taylor.

GEISSOSPERMUM LÆVE.—This apocynaceous tree furnishes Pao-Pereira bark, which is highly esteemed in Brazil as a tonic and astringent and especially for reducing undue *rapidity of the pulse.* A decoction is made in the proportion of 3 parts to 50, of which a wineglassful or more is to be taken in the course of a day. The bark contains the alkaloid *geissospermine.*

GELSEMIUM (U. S. Ph., Br. Ph.), yellow jasmine, is the dried rhizome and rootlets of *Gelsemium sempervirens*, a climbing plant native to the Southern United States. In commerce it occurs in pieces which vary in size from half an inch to several inches in length. These are cylindrical and have a diameter of from a quarter to three quarters of an inch. Externally its colour is light yellowish-brown marked by purplish longitudinal lines. The odour is aromatic and oppressive and the taste bitter. Apart from the usual vegetable constituents gelsemium contains *gelsemic*, or *gelseminic, acid* and an alkaloid, *gelsemine*, the latter being obtainable as a brittle, transparent, and crystalline solid without odour, but of a very bitter taste. It is probable that the drug contains a second alkaloid to which the name *gelseminine* has been given.

The action of gelsemium varies widely with the susceptibility of the individual. Its mildest therapeutic effect is the production of a feeling of languor and relaxation, with perhaps a slight amount of circulatory sedation. After larger doses the languor becomes more pronounced and there is weakening of muscular power, with diminution in the force and rapidity of the heart's action and of the respiration, drooping of the eyelids, dilatation of the pupil, dizziness, dimness of vision, and diplopia, together with a diminution of general sensibility. If the dose has been toxic the prostration and muscular relaxation are extreme, the eyelids droop and the jaw as well, while speech is difficult or impossible from paralysis of the muscles of articulation. The disturbances of vision are pronounced, and partial or complete blindness may occur, while the pupil is widely dilated and no longer reacts to light. The breathing is laboured and the heart's action feeble and irregular; the skin is pale, cold, and bathed in perspiration. A sense of numbness is felt throughout the body, and, though consciousness is long preserved, drowsiness or stupor finally appears. The respiration grows feebler and feebler, and death finally results from paralysis of respiration. The amount of gelsemium necessary to produce death will vary much with circumstances. Though the ingestion of a drachm of the fluid extract has in several cases been recovered from, a dose of 12 minims is said to have caused death in a child three years old. The treatment in cases of poisoning with gelsemium comprises the evacuation of the stomach, the maintenance of the horizontal posture, and the employment of heat and medicinal stimulants. It is said that morphine given in considerable doses is a valuable remedy, and nitroglycerin also has been recommended.

So far as the explanation of its physiological action is concerned, gelsemium is believed to produce its general muscular and sensory phenomena by a depressing and paralyzing action upon the spinal cord. The circulatory symptoms are thought to be due to a direct action upon the heart. The dilatation of the pupil is the result of peripheral oculo-motor paralysis, since it follows the local application of gelsemine, and the asphyxia is due to central respiratory paralysis. The drug is one whose action is generally prompt, about half an hour being required for the appearance of its manifestations when it is given by the mouth. The duration of its effects is usually between two and three hours.

Like aconite, gelsemium may be used as a *febrifuge* and *circulatory sedative* in *fevers*

and *inflammations*, but in sthenic conditions it possesses far less power than aconite, and in asthenic conditions it is contra-indicated. Nevertheless, some writers praise it for use in *malarial fevers* as an adjuvant of quinine, and the remedy owes its introduction to its empirical employment in the malarial fevers of our Southern States. Bartholow places a high value upon the action of gelsemium in *pneumonia* and *pleurisy*, regarding the circulatory and respiratory sedation, the lowering of temperature, the diminution of cough, and the production of sweating as much to be desired. In pneumonia he recommends that from 3- to 5-minim doses of the fluid extract be given every two hours " to maintain a constant effect within the limits of safety." Wood, however, regards its use in pneumonia in the doses required for these effects as too hazardous.

It is in *spasmodic conditions* that gelsemium exerts its most valuable influences. *Asthma*, *whooping-cough*, and that *cough of a hacking and unproductive character* so often seen in the phthisical are often much benefited by its use. *Laryngismus stridulus*, *chorea*, *facial spasm*, and some forms of *dysmenorrhœa* are at times relieved. In certain painful affections gelsemium has a considerable repute and thus are treated *facial*, *intercostal*, *ovarian*, and other *neuralgias*. Even *sciatica* may be benefited by it, and its use in neuralgia is highly to be recommended. Gelsemium is recommended by Bulkley for the relief of *itching*, and is said to be excellent in the treatment of eczema, in doses of from 3 to 10 drops of the tincture given at intervals of two or three hours until its physiological effects are observed. In conditions of motor excitement benefit may follow the use of gelsemium in full doses, and *in mania with motor excitement and wakefulness* Bartholow rates it as superior to conium. Locally a solution of the alkaloid *gelseminine* has been recommended and employed as a *mydriatic* and to *paralyze accommodation*, but, though its action is advantageous in that it passes away within a few hours, this use of the drug has never become widespread, and the danger of absorption and general poisoning would seem possible.

The fluid extract of gelsemium, *extractum gelsemii fluidum* (U. S. Ph.), may be given in doses of from 2 to 5 minims. The dose of the alcoholic extract, *extractum gelsemii alcoholicum* (Br. Ph.), is from ½ to 2 grains. The tincture of gelsemium, *tinctura gelsemii* (U. S. Ph., Br. Ph.), is given in doses of from 5 to 20 minims. The administration of gelsemium may be repeated at intervals of two or three hours and the doses cautiously increased until its physiological effects become manifest. Though the alkaloid *gelsemine*, as well as its hydrochloride, has been employed medicinally in doses of from $\frac{1}{60}$ to $\frac{1}{20}$ of a grain (*Extra Pharmacopœia*, 8th ed., 1895), its preparation is too uncertain and our familiarity with it is too slight to make it an altogether safe drug, and, furthermore, it possesses little or no therapeutic advantage over the official preparations of gelsemium.

Henry A. Griffin.

GENTIAN, *gentiana* (U. S. Ph.), *gentianæ radix* (Br. Ph.), *radix gentianæ* (Ger. Ph.)—The root of *Gentiana lutea* is the official gentian of nearly all the pharmacopœias, but the roots of several other European species are often substituted for it, and this is unobjectionable, as their properties are identical with those of the official article. In the United States the roots of *Gentiana puberula*, *Gentiana saponaria*, and *Gentiana Andrewsii*, all of which are known indifferently as the blue gentian and have the same properties, are used to a considerable extent in the various localities where they are found. Gentian is a pure, non-astringent bitter tonic which is extensively used to arouse the appetite and promote digestion in all forms of *dyspepsia*, being regarded as especially valuable in cases in which there is a gouty taint. In large doses, or if its administration is continued too long, it is apt to give rise to headache, dizziness, and the other symptoms produced by large doses of quinine. It has feeble antiperiodic properties, and on that account is a very good adjuvant to quinine in the treatment of *intermittent fever* where a stomachic is desirable. Where no other material has been at hand, tents have been made of it; although not so good as those of sponge or tupelo wood, they have answered the purpose fairly well. On account of the large amount of sugar they contain, infusions of gentian do not keep well, and, unless very recently prepared, are to be avoided. Their freedom from all astringent properties makes the fluid extract and the compound tincture suitable vehicles for the administration of other tonics, etc., when constipation exists, and the salts of iron are not precipitated by them. In some countries an alcoholic liquor is obtained by the distillation of an infusion which has been allowed to ferment.

The extract, *extractum gentianæ* (U. S. Ph., Br. Ph.), is used largely as an excipient for pills, but may be given by itself in 5- to 10-grain doses. The tinctures of the Fr. Cod. and the Ger. Ph., *tinctura gentianæ*, are of the same strength and may be used in ½- to 1-fl. drachm doses. The Fr. Cod. also recognises an alkaline tincture of gentian containing 1 part in 100 parts of sodium carbonate, also a wine of gentian; they are given in 1- and 4-fl. drachm doses respectively; the compound tincture, *tinctura gentianæ composita* (U. S. Ph., Br. Ph.), contains orange peel and cardamom seeds, and is a very useful stomachic in doses of from 1 to 2 fl. oz. The fluid extract, *extractum gentianæ fluidum* (U. S. Ph.), has no advantages over the other preparations; it may be given in 10- to 20-drop doses. The compound infusion, *infusum gentianæ compositum* (Br. Ph.), is a very excellent preparation when not too old; it contains small amounts of coriander and bitter-orange peel, and may be given in quantities up to a fl. oz.

Russell H. Nevins.

GEOFFRÆA.—See Andira.

GERANIUM (U. S. Ph.), the rhizome of *Geranium maculatum*, the spotted crane's-bill, is a mild astringent used topically in the

treatment of *inflammatory affections of the throat, gonorrhœa, leucorrhœa,* and *indolent ulcers,* and internally in *diarrhœa, dysentery,* and *hæmorrhages.* The dose of the powder is from 10 to 30 grains; that of the fluid extract, *extractum geranii fluidum* (U. S. Ph.), is from 10 to 30 minims.

GERMANDER.—See Teucrium.

GERMICIDES.—Germicides are those material substances or physical forces which, when brought into proper contact with pathogenic bacteria or their spores, either kill them or suspend, for the time being, their functions, both nutritive and reproductive.

This definition, of course, applies only in medical technology. Between the suspension of their vital functions and their actual destruction the difference is one of degree, so that, as a rule, those agents which are capable of doing the first, in weak solutions will, when more concentrated, kill the bacteria.

It is to be noted that the spores, as well as the bacteria containing them, are less easily destroyed than the simpler forms (*Schizomycetes*), which reproduce themselves by fission or budding. *It is also a question of time.* It requires a longer exposure to the action of the substance or agent to actually destroy bacteria or their germs than to simply retard or prevent their growth and reproduction.

This distinction makes necessary the adoption of two terms—viz., *antiseptics* and *disinfectants* (see Antiseptics). Antiseptics retard or actually prevent further growth or proliferation of disease germs so long as they are in contact with them or can exert their devitalizing influence upon them, and, for a short time after the cessation of their action, the time required for recuperation. Disinfectants completely destroy the vitality of low vegetable forms, so that they are entirely wiped out of existence, and no progeny spring up to take their places. If the world, or a country, or state, or community could be thoroughly subjected to the action of antiseptics, there would be no further germ diseases there until the effect of the antiseptic had worn off or new infective material been introduced from without.

By the words *substances* and *agents* we mean, first, bodies which chemically decompose the organic matters of which the infective bacteria are made up; and, second, the so-called physical forces, but, more particularly, *heat.*

Of course, the substances which, according to the laws of chemical action, are capable of reacting with the complex and unstable molecules of organic bodies, decomposing them and converting them into lifeless matter, are innumerable, so that we may say that, in one sense, the list of antiseptics and disinfectants is almost endless.

But there is only a small number, comparatively, that are available. To be available for practical application it is necessary that they should be soluble, that they should be effective in a moderately weak solution, that they should act quickly, that they should act thoroughly, that the chemical reaction between them and the infective protoplasmic body should take place at a convenient temperature, and, finally, when it is desired to disinfect fabrics and other valuable articles, that they should be of such a nature as to kill the disease germs without acting destructively upon the object or material to be disinfected.

In all disinfecting operations on a large scale the question of expense must be considered; but, fortunately, the most powerful agents of this class are effectual in such weak solutions that even of the amount required to sterilize large quantities of fabrics, etc., the cost is not excessive.

Of course, in quarantine operations, where whole cargoes of merchandise must be rendered innocuous, the necessary plant is costly, though, in relation to the amount of material operated upon, the individual disinfections are not expensive.

It will be useful to consider these various requirements *seriatim,* because the analysis of the group, which will be a necessary part of such a study, will be an aid to the memory when we come to the practical application of our knowledge of these substances.

It is scarcely necessary to say that the devitalizing action of a disinfectant upon the microbic organisms of infection is a chemical action. In order that there should be a chemical reaction between any two bodies, it is essential that their molecules should be brought into contact with one another, or, to speak more correctly, that they should be brought near enough to one another to permit the mutual attractions of the atoms which enter into their composition to exert their disruptive force, which breaks up the molecules and generates new ones of an entirely different character. For this to occur, the power of cohesion which holds together the molecules of solid bodies must be overcome, so that the molecules of one may freely mingle with those of the other, as is only possible when they are in the fluid or gaseous states. Hence it is necessary, in the disinfection of materials, to have a soluble chemical substance.

In medical and surgical practice drugs which are nearly or quite insoluble in water are used mainly as antiseptics—*e. g.*, iodoform, which is very extensively applied to the surfaces of ulcers, wounds, and diseased skin and mucous membranes. In this case the mode of action is that, the fluids of the body coming in contact with the superficies of the iodoform (or other substance not soluble in water), a reaction takes place with the molecules at the surface of the small grains of the powder, these molecules being less strongly influenced by the power of cohesion than those more deeply situated, and, when they are decomposed, those that were next to them and that are non-superficial are in their turn attacked and removed; and. this process continuing, the iodoform will finally disappear. The liberated iodine and perhaps other newly formed bodies, which are soluble, are then the true antiseptics. The action in such a case

is slow, and therein consists its advantage, for on a wound dressing the slow but continuous influence is what is needful.

Gaseous bodies are not so reliable as fluids for the work of antisepsis or disinfection, as, owing to the great motility of their molecules, they are not so readily held in contact with what is to be disinfected, unless the object is moist or there is enough moisture in the air to cause some precipitation on the surfaces with which it comes in contact. It is on this account that, in burning sulphur to disinfect rooms, we should, in order to assure the success of the process, have water boiling in the room at the same time.

And this also explains the fact—which seems at first sight paradoxical—that in disinfecting ships or large compartments with steam it is found that, although steam is made use of as a convenient bearer of heat, and though steam under pressure has a higher temperature than when it is escaping into the air, it has in the latter condition a more rapid and certain effect than in the former.

The explanation may be also given in the form of a comparison of the physical state of water when it appears as escaping steam with that which it presents when suspended in the atmosphere as a cloud or deposited on surfaces as dew.

The formation of clouds, long an unexplained phenomenon, is now made comprehensible by the discovery that when at a given temperature the atmosphere contains as much of the vapour of water as can be formed at that degree of heat; if the temperature is lowered, the molecules tend to approach one another more closely and assume the liquid form.

Their coalescence, however, is facilitated by the presence of any solid body at a lower temperature, as the diminished amplitude of vibration favours their contact with and adhesion to that body. The microscopic particles of atmospheric dust offer the requisite surfaces, and the water is precipitated on them in drops so light as to continue to float, but which, having been changed from a vapour to a liquid, are visible. A further reduction of temperature causes increased precipitation, and the drops, increasing in size, become too heavy to be buoyed up by the dust particles and fall to the earth as rain. Now, it will be observed that in a room in which a vessel of ice water is wet with dew, solid bodies in its immediate neighbourhood are dry. A slightly deliquescent powder, which in the air of the room may be only slightly moist, will, if laid on the cold vessel before the latter has become moist, liquefy rapidly. In like manner will escaping steam, which is no longer a vapour when it becomes visible, but is composed of minute globules of water, moisten everything with which it comes in contact, and this water, deposited on their surfaces and penetrating between their superficial molecules, brings them more rapidly under the influence of the higher temperature, not only by contact but by preventing evaporation from such of them as contain moisture. This principle explains also the fact that dry heat is not so powerful as moist heat at the same degree.

That they should be effective in a moderately weak solution is important in three ways. In the first place, if it were necessary to use a very strong solution, it would greatly increase the expense, as in the case of carbolic acid, which is, for many purposes, a most valuable antiseptic and disinfectant; but, especially for the latter purpose, the solution must be so strong that it is too expensive. This substance has been greatly abused, and its reputation injured by ignorance or neglect of this fact. Even the pure acid when added to large quantities of liquid, as in sewers, drain pipes, and cesspools, becomes so diluted as to have but little effect.

Rapidity of action is very important, because, for instance, in the sick-room, if the discharges from a patient suffering from a contagious disease are treated with a slowly acting disinfectant, there is danger that some person in attendance may be infected before the noxious matters have become sterilized. The importance of this observation to the welfare of those in charge of diphtheritic cases is evident.

That the disinfecting substance should act thoroughly only needs to be mentioned in order to call attention to the fact that some of these chemicals, by coagulating the external portions of organic bodies, erect a barrier to their own invasion. Bichloride of mercury, for example, particularly if it is used in too strong a solution, may in this way defeat the object for the accomplishment of which it is employed.

Nitrate of silver, too, which is the most powerful member of the class, when used in a high dilution will, when concentrated, cause the arrest of its own progress by producing a firm, impenetrable coagulum on the surface.

This point is of great importance in the treatment of *diphtheria* and *phagedœnic* and *gangrenous ulcers*, and accounts to some extent for the failure of the former practice of applying to diphtheritic lesions of the throat very strong coagulating drugs.

That an antiseptic or disinfectant should be available at ordinary temperatures is a categorical proposition, as those substances which are used are all efficient in this way. The physical force, heat, is of itself unerringly competent when of the proper degree.

The necessity of finding disinfectants which are capable of thoroughly sterilizing textile materials without injuring the fabrics themselves abbreviates very much the list of substances which are available for this purpose. The injury may consist in staining or the disinfectant may actually corrode and destroy the materials with which it comes in contact. Practically we are almost confined to the use of heat for this purpose. And this is not to be considered as a disadvantage, for it is necessary in the case of clothing and bedding that the articles should be washed after having been in contact with patients who have any contagious disease, and boiling thoroughly and for a longer time than is usual in the laundry

meets the demands of both hygiene and cleanliness.*

This principle is of still more moment when applied to the human organism. It has been a great desideratum since the discovery of the microbic origin of some diseases to find substances which could be administered to those suffering from maladies of that class with the certainty of destroying or devitalizing the germs without at the same time inflicting a parallel injury upon the tissues which are invaded by them.

If the statements that have recently been made concerning certain bacterial products, such as antidotes to diseases like tuberculosis and diphtheria, should be justified, this great obstacle to the successful treatment of some of the most malignant diseases which afflict mankind will be removed, and the bright hope encouraged that our profession, which in its history has, unlike all others, sought only to benefit the race, has truly entered upon its golden age.

The substances derived from the inorganic world all have the same fault—viz., that the cells of the animal body seem to be practically as much affected by them as those unicellular vegetable organisms which are the agents of infection. From the organic kingdom, however, there is reason to hope that we may in time obtain such antidotal bodies as are needed to neutralize the action of the pathogenic bacteria. The hope is justified by the fact that the extraordinarily complex molecules of the organic compounds, especially the proteid or protoplasmic proximate principles, are susceptible of reactions whose variety and complexity, not approachable in the inorganic world, favour the formation of compounds of almost infinite variation, among which are those exhibiting the so-called catalytic property, and others whose specific or, as we say, elective operation on certain cells or tissues only encourages the expectation that some will be found whose special qualities will favour a selection of these parasitic cells without injurious effects on the tissues of man. The action of the cinchona alkaloids in destroying or devitalizing the miasmatic germ of the paludal fevers is probably paralleled by that of other organic compounds yet to be discovered.

The evidence at present in the possession of the pathologists is sufficient to make the microbic origin of the malarial fevers certain, and the only question in regard to the action of the cinchona salts and the essential oil of eucalyptus is as to whether they act directly upon the disease germs themselves or indirectly by so modifying the fluids and tissues of the body that they can no longer support the growth of these pathogenic micro-organisms.

A comparison of the different agents which are or may be employed for germicidal purposes is difficult, as their values relatively to one another will vary according to the point of view. The qualities which may be considered as especially advantageous are three: First, efficiency; second, general availability; third, cheapness. As, however, I shall only consider for the present those which are highly efficient, the differences in that respect will not be of great importance. The question of cheapness may also be to some extent disregarded, as the differences are not so great as to outweigh the advantages of efficiency and availability. In most cases, where it becomes necessary to disinfect sick-rooms, or the clothing, bedding, and other fomites, either during the illness or after its termination in death or recovery, the first question which confronts the physician is as to which is the most available among the disinfectants of known potency.

I shall, then, endeavour to indicate those germicides which will be found most useful in the various phases of a physician's practical labours.

In the sick-room we employ both antisepsis and disinfection—the former to prevent the propagation of disease germs that may become lodged on the walls, floor, furniture, and whatever else may be in the room, as well as on the clothing and persons of the attendants; the latter to destroy those which are more densely aggregated on the bedding and garments of the patient, in the discharges, on the receptacles of the discharges, on all things connected with the toilet of the patient, such as wash basins, towels, sponges, etc., and the wash water and the hands and clothing of the nurse.

It has long been thought an important thing to use some antiseptic for the air of the sick-room, and all manner of substances have been recommended and employed for that purpose, though it is now known that they were of no use. One of the most highly recommended of these was lime, which was to be put in plates or other porcelain vessels about the room. Sometimes it was slaked in the room. Chlorinated lime, though recognised as a more powerful agent, could seldom be used, on account of the unpleasant and at times injurious nature of its fumes.

Charcoal was used to absorb noxious gases. Dr. Parkes, the eminent sanitarian and one of the greatest of the pioneers in the scientific study of hygiene, recommended a stick of phosphorus, partially immersed in water, in a wide-mouthed bottle. This was undoubtedly one of the best of the oxidizing agents. Finally came carbolic acid, a weak solution of which was used to wet cloths which were hung about the room and in the doorway. It was also sprinkled on the floor, walls, etc.; but the solutions were so weak as to be utterly worthless. Chloride of zinc is good as a deodorizer, though of little value as an antiseptic—of no value, in fact, as it has been usually employed.

The only means of keeping the air of a sick-room pure is to maintain thorough ventilation, and this can be done, even in cold weather, by tacking coarse unbleached muslin across the space of the open windows and doors. The muslin breaks the force of the draught but lets the air pass freely.

* For anything to be clean, in the ordinary sense of the term, and to be free from the virus of contagious disease, are two distinct properties. "*Dirt*" has been defined as "matter out of place," but perfectly harmless matter may be out of place.

And in winter there should be a good fire in the room to keep the temperature at the proper point, while the air is allowed to enter freely. The muslin which closes the doorway should, in the case of very contagious diseases, such as *small-pox*, *scarlatina*, and *diphtheria*, be kept moist with a solution of bichloride or biniodide of mercury (1 to 1,000). This will favour the arrest of floating bodies of all kinds and their disinfection when arrested. In order to make this barrier practically impermeable to the micro-organisms suspended in the air, it is only necessary to double it. The superposition of one layer upon another will make an almost perfect air-filter. The walls and floor may be moistened with the same solution, distributed by means of an atomizing apparatus. If the carpet is not removed, as it should be in cases of *exanthematous fevers* and *diphtheria*, it should not be swept. It is the great receptacle of atmospheric dust, and probably more contagion is spread by the feet of attendants, taking the dust from the air and carpets and carrying it outside, than in any other way. The carpet should therefore be moistened at least twice a day with one of the solutions already mentioned, or with a solution (from 3 to 5 per cent.) of carbolic acid. The carbolic-acid solution is particularly valuable, because in order to make a thorough solution it is necessary to add glycerin, which does not dry and will hold the dust. Of course the carpet must suffer, but that is of minor importance when we are dealing with such virulent enemies to human life as variola, typhus, and the other infectious fevers. If the floor is bare, as it should be, it should be wiped twice a day with cloths wrung out of the disinfectant solution. It should be remembered that the cloths are only moist, not dripping wet, and the floor simply wiped with them. The cloths are then to be put into a porcelain-lined vessel containing a solution, twice as strong as the first, of one of these or of some other germicide, and may be taken out again and used as before, as an immersion of half a day will surely disinfect them. The attendants should have two outer garments and two pairs of slippers, one to be kept in the sick-room, the other in the adjoining apartment. When leaving the room he or she, standing by the door, should take off the outer garment, and removing the slippers, step from them into the outer room or hall without having touched the stockings to the floor of the inner room; and when out, put on the other wrap and slippers, wash the hands in a carbolic-acid solution (1 to 100) with strong soap, at the same time moistening the hair slightly so as to prevent the detachment of any dust that may have settled on it.

Though not absolutely insuring safety, this is about as much as can be carried out practically in the way of preventing the carrying of contagion by a nurse; it is a method very easy to understand, and one which will commend itself to the non-professional mind.

The success of our antiseptic precautionary measures in private practice will depend very largely upon their simplicity, and it may be accepted as a safe principle, applicable to all medical and surgical aseptic methods, that their usefulness varies in an inverse ratio with their complexity; and that it is better to have a method not absolutely perfect perfectly applied than to have one which is without a flaw but which, on account of its numerous details, is almost certain not to be faithfully carried out by assistants and nurses, either because of their failure to comprehend its rationale or because it is wearisome and excites them to revolt. We see this in hospital practice, where with the best discipline we can not always be assured of the intelligence or conscientiousness of subordinates.

To prevent, so far as possible, the exfoliated epidermic particles from being disseminated in the air of the sick-chamber, it is advisable to anoint the patient two or three times daily with some bland unguent which is rendered antiseptic by the incorporation with it of some unirritating germicidal drug—*e. g.*, salicylic acid, oil of wintergreen, or boric acid.

The ordinary ointment of rose water is agreeable, and to an ounce of it may be added of the substances mentioned and in the order given 10 grains, 15 drops, or a drachm. Instead of the cold cream, lanolin may be used or simple cerate. Vaseline is found to be too irritating for such applications with many persons.

To cleanse the mouth and throat a 1-per-cent. solution of carbolic acid (crystallized), with 10 grains of tannic acid and 20 minims of glycerin to the ounce, may be used as a wash and gargle. This helps very materially toward neutralizing the contagion in the sputa, which, in the main, come from the upper air-passages. The same wash may occasionally be injected in small quantities into the nose. With the patient in the dorsal decubitus, the fluid passes back into the nasal pharynx and is expelled, clearing those recesses which are, of all others, most dangerous as breeding places for pathogenic organisms.

Though it is not much dwelt upon by writers, I regard this as one of the most important points in the treatment of the exanthemata, on account both of the patient and of those in waiting upon him. A small syringe, the nozzle of which is wrapped so as to make it large and bulbous, like the nasal tip of a Politzer's inflating tube, is far more serviceable than an atomizing apparatus.

If the solution which I recommend is found to be too irritating, its use may be preceded by the instillation of a few drops of a 1-per-cent. solution of cocaine into the nostrils. This will not anæsthetize the mucous membrane, but will benumb it sufficiently to make the operation bearable, and it is safe.

It has not been proved that the expired air contains any bacteria or spores, unless, perhaps, during the act of coughing, sneezing, or other violent expulsive respiratory effort.

The *bedding* is one of the great carriers of contagion. To obviate the dangers from this source, it is not by any means sufficient to disinfect the sheets and other bedclothes after removal from the couch. They should, as far as it is practicable, be rendered antiseptic be-

forehand. To this end they should be soaked in a solution of mercuric chloride (1 to 2,000) for half an hour, taken out and dried by the fire without much wringing, folded, and laid by ready for use.

On being removed from the bed they should be immersed in a large wash boiler containing a solution of bichloride of mercury (1 to 500). After they have been kept in this for an hour the boiler is put upon the stove and left there for half an hour after the water has begun to boil.

The bedpan or *pot de chambre* should contain half a pint of some cheap disinfectant at all times, so that when called for it may be ready at once to receive and sterilize the evacuated matters. If the latter are alvine and in large quantity, enough more of the solution should be poured on to completely submerge them. For this purpose a good solution is the chlorinated soda of Labarraque, or a 5-per-cent. solution of carbolic acid.

If it should become necessary to do some of this coarser disinfecting at once, say at the physician's first visit to the patient, and in the absence of the other agents named, there should be a galvanic battery in the house. Either the chloride of ammonium from a Leclanché cell or the sulphate of copper from a gravity cell could be used, crushing the salt and dissolving it in hot water in the proportion of an ounce or more to the pint.

For the disinfection of fæcal discharges, vomited matters, and sputum, and for the purification of vessels or of water pipes as far down as the traps, the solutions should be very much stronger than for the other purposes mentioned, as the intermingling of the noxious matters with the germicidal liquid is not so rapid, and the quantity is more uncertain. For lead pipes carbolic acid is the best, as it does not corrode them.

During the progress of the disease the patient should, if not receiving baths for antipyretic purposes, be washed at least every second day. This may be done with warm water containing one tenth of its volume of alcohol and 2 fl. drachms of liquor ammoniæ to the pint, a pleasant toilet soap being used with it if desired. This will remove the remains of the ointment and the epithelial *débris* from the surface of the body, and will be of sufficient antiseptic strength for the time; but, after the washing, the wash rag should be left in the basin and a strong antiseptic solution added. If a towel is used, it should be thrown into the wash boiler to be boiled. The washing of the body should be continued through the convalescence, its frequency perhaps being diminished and the strength of the solution decreased, in accordance with the judgment of the medical attendant.

When the period of contagiousness has passed, another room should be prepared for the reception of the convalescent, and he should be removed to it in such a manner as to avoid, as far as possible, the carrying of any of the *materies morbi* with him. By a very simple method we can accomplish this transfer with a minimum risk of coincident transportation of the pathogenic organisms. Absolute certainty in such a matter is, of course, unattainable. The patient, whose nightdress has been removed, is rolled over on to his face, and the back and sides are washed with the solution already mentioned. Two antiseptic sheets are then brought, one of which is folded longitudinally and spread upon the bed so as to cover the side upon which he has been lying, from the edge, at one side, far enough over to be tucked under him. The other sheet is laid upon this; he is rolled on to it, turning on to his back; the abdomen and chest are wiped with the disinfected solution, and he is then carried in this sheet (or blanket), which has not come in contact with the one on which he had lain before the bath, into the fresh apartment. At this period of the convalescence, of course, a person with clean clothing can enter the room and carry him out without any danger of infection from the atmospheric dust of the room. The room, it is needless to say, must be warm during the time consumed in making this change. Once the patient is in the new room, fresh, clean garments can be put on him.

It will be found in practice that all the necessary antiseptic or disinfectant operations of the sick-room can be made as simple as those which I have here described.

I must now call the attention of the practitioner to a matter which is of even more importance than the germicidal management of the sick-room and its suffering occupant. This is, that there is probably much more danger of the contagion being spread by the physician and the attendants, including all those who enter the room, than by the patient himself. The physician, of course, remains for so short a time at the bedside that he may, with proper care, avoid the calamity of carrying disease and death where his mission is to comfort and restore.

But the nurse, who must of necessity remain by the patient for hours, is exposed to such a prolonged and unremitting shower of falling and eddying dust—containing, as it does, an admixture of pathogenic bacteria and their spores, one or both—that she can not leave the sick-room without taking many of them with her. In fact, all that is possible under the circumstances is, as far as practicable, to reduce the danger by her wearing a short gown, changing her slippers at the door, and having two light wrappers which reach to the bottom of the skirts without rubbing the tops of the shoes; removing one, she passes out of the room, and assumes the other after she has reached the hallway. On returning to the room, she of course should reverse the process. She should, in addition to these precautions, take the further one of always having a wash basin and wash rag just outside the door, and, before putting on the clean wrap, wipe her hands with the rag, moistened with a disinfectant solution.

The disinfection of the sick-room after the removal of the patient from it is a matter of great moment, but one which has never been very effectively attended to until within a very few years—supposing that the doctrines

at present prevailing in the scientific world are in accordance with the actual facts in the world of vital phenomena. Former attempts at thorough disinfection, however, while crude as compared with the present methods, were not futile, but were unquestionably useful and considerably lessened the danger of the spread of contagious diseases. In fact, we can not now say that our work in this direction, in private practice or, indeed, in the hospitals, is by any means perfect. In the public service, where there is absolute control, with a reliable financial basis of operations, and where people can be absolutely removed from all contact with goods or domicile, perfect results are secured. But a hospital, a private dwelling, or a hotel can not be emptied of its inhabitants and given over to the treatment of a sanitary engineer, who is provided with everything necessary for the systematic and thorough prosecution of his work.

The private practitioner simply tries to disinfect the sick-room as thoroughly as possible, and, when necessary, to put the whole house in a sanitary condition, approximately.

The room—every surface in it—is scrubbed. Hot water, strong soap, and some disinfectant dissolved in the water are needed. Moderately stiff brushes should be used, but if they are too wiry they do not reach the inequalities of the surfaces so well as when they have some pliability. If the apartment has been occupied by a person with *variola*, mild or severe, or by a *scarlatina* patient whose disease has been characterized by bad skin and throat lesions sure to throw off into the surrounding air clouds of the pathogenic organisms peculiar to it, or if the disease has been *diphtheria*, and the throat lesions such as to produce much swelling and the necessity of frequent spitting or clearing of the throat—in any of these cases the walls and ceiling should be thoroughly scrubbed without any hesitation on account of the cost of their decoration.

Any case of nasal diphtheria which we recognise by the peculiar pink margin of the nostrils, which show a thin sanious discharge, is sufficiently dangerous to indicate this thorough treatment of the room, even though, as sometimes occurs, the throat may exhibit no membrane except to the rhinoscopic mirror, the successful manipulation of which may not be possible, even to an expert laryngoscopist.

The sanious or sanio-purulent discharge from the nasal passages is apt to be more widely disseminated than the sputa, because of its getting on hands, face, handkerchiefs, bedclothes, towels, and other objects, and the conditions are favourable for drying and pulverization. I take the responsibility of suggesting this limited discrimination between cases which, with thorough disinfection or destruction of fomites and general cleanliness and renovation of premises, offer no appreciable menace to the health and lives of others, and those in which there being doubt on the subject, the benefit of the doubt is given to humanity—not as questioning the propriety of absolutely thorough disinfection in every case of these exanthematous fevers, but because the knowledge of the actual experiences in the every-day life of a general practitioner afforded by years of labour in the field convinces me that such discriminations are forced upon medical men by the conditions of life in our great cities, and that a safe working rule is of advantage to all interested.

I will now give a more detailed account of the germicidal agents, and attempt to point out what is of practical importance about them to the active, busy physician.

The foregoing discussion of the practical application will, I hope, enable the reader to appreciate the special excellences of the individual members of the group, and, on the other hand, to recognise the objections which apply to one or another of them.

Heat.—This is so valuable a weapon against the zymotic and toxic diseases generally, and in every department of medicine, that it easily ranks foremost in its class. Its great virtues are that it is so extensively applicable, and that we can use it with certainty as to what we are doing and as to what the result will be, providing it is so applied as to reach every part of that which we wish to disinfect. Fortunately, the temperatures necessary to destroy the bacteria of disease are so moderate that they are always available where there is a stove.

As the hardiest of these bacteria are destroyed by the temperature of boiling water, we have in every house a means of defence. This makes the best means of sterilizing the clothing and bed covers of the sick. The precaution to which I referred above, however—viz., to put these articles into a vessel containing a solution of some disinfectant immediately after their removal—is important, as it is almost invariably necessary, in private dwellings, to carry the soiled objects through a part of the house to reach the laundry.

It is further necessary, in order to insure absolute sterilization, to have an exposure of more than the four minutes which sufficed in Dr. Sternberg's experiments, and to have sufficient water to allow of the thorough immersion of the materials, for if they are packed into the boiler as much as is customary with laundresses, the heat may not in all parts be of the requisite degree. Any pieces that are badly soiled with fæces, vomit, blood, or the cutaneous exudates of variola, etc., should be burned. They can be safely transported to the stove or furnace if wrapped carefully in strong paper. Besides the wide applicability of moist heat, we have the further advantage of being able to use heat without moisture in the sterilization of many fabrics and materials which would be injured or destroyed by hot water or steam. Thus, prints and numerous dyed goods may be disinfected in an oven without affecting the colours. This, when the apparatus is the ordinary stove-oven, must be done with great caution; but, by the use of a proper thermometer, the oven can be tested beforehand, so as to ascertain the amount of fire and regulation of dampers appropriate for the purpose.

Sunlight is a constantly acting germicidal force, the actinic rays of the white solar light

possessing, as is well known, great power to influence the decomposition and recomposition of organic and inorganic molecules. Its importance in the field of sanitation is limited, but not to be underestimated. This applies especially to the airing and sunning of rooms, of persons, and of all manner of goods and fabrics.

Oxygen.—In connection with heat and light it is well to mention oxygen for the purpose of warning against the popular fallacy that it is a useful agent of disinfection. Careful experimentation has shown that it is of no practical value. Ozone in the presence of moisture has some oxidizing power, but it is of no service in practical sanitation. *Oxygen in its nascent phase*—that is, at the instant of its liberation from combinations with other elements—is extremely active, and this is the basis of action of many disinfectant substances, such as the chlorine compounds, etc. When there is moisture present the molecule is broken up, the hydrogen recombines, and the oxygen atom, freed from the attraction to its former companions, is for the instant "at large," if we may use that expressive phrase. Now, the force which impels every atom in the universe to join with some other to form a molecule is absolutely irresistible, and the oxygen atoms will instantaneously pair with one another to form oxygen molecules, unless there are present other atoms toward which they are drawn more strongly than toward those of their own kind. So that, given the conditions, the oxidation is inevitable. But no such conditions are furnished by the simple exposure of organic bodies to free oxygen either in the air or by itself.

Oxidizing Agents.—Their mode of action has already been sufficiently discussed. The most widely used member of this group is *chlorinated lime*, which must not be confounded with *chloride of calcium*, a simple, stable compound. A mistake has been made possible by the name *chloride of lime* having been applied to both substances. Chlorinated lime is a mixture the exact nature of whose constituent parts is not as yet definitely determined; but the source of its power as a germicide is in the *hypochlorite of calcium* which it contains. In the presence of moisture the hypochlorite is broken up and the chlorine set free. The latter removes the hydrogen of the water, forming hydrogen chloride (the basis of hydrochloric acid), and the oxygen, in the nascent condition, oxidizes the substances which are to be destroyed. Chlorinated lime is put up in convenient packages by the manufacturing chemists, and can always be obtained from the druggists and at many grocers. It is sold in air-tight boxes, as it absorbs moisture from the atmosphere, deliquesces, and thereby loses a portion of its oxidizing power.

It is used mainly for disinfecting garments (but not coloured ones, for it is a potent bleaching agent), bedclothes, privies, and any vessels or dishes that have been used where there is contagion, and to put into bedpans or commodes in order that the evacuated matters may be discharged into it. It may also be put into cups for the reception of sputa, if its odour does not nauseate the patient.

I may remark here that the best receptacle for sputa is a thick porcelain teacup or coffee-cup. The cups usually employed, which are narrowed and convex at the top, with an orifice very much smaller than the cup itself, are not easily cleaned; and paper boxes, while they have the advantage of being combustible, are apt to be left too long before being burned. The open cup, though it may be kept covered by a saucer, allows of free inspection of its contents, and constantly suggests the idea of emptying and cleaning it. Chlorinated lime is of no use as a means of disinfecting the air of a room. Neither does it act with sufficient rapidity for the scrubbing of floors, etc. Discharges received in it should be left to stand for an hour before being disposed of. Textile fabrics should be left in it for the same length of time, then transferred, without wringing, to the boiler, and boiled for half an hour. In regard to boiling I will call attention to a possible source of failure—viz., that, if special instructions are not given, the laundress, or even the nurse, as I have once observed, may put the articles into boiling water, and thus reduce its temperature so much that fifteen or twenty minutes may go by before the ebullition begins again. The direction should be to leave them in the water for an hour *after it begins to boil.*

The disinfectant solution of chlorinated lime is of the strength of 6 oz. to a gallon of water.*

The time prescribed is about twice that given by experimenters whose observations were made under the most favourable circumstances.

Chlorine.—Chlorine gas is a powerful disinfectant *if properly used.* It is active by virtue of its affinity for hydrogen, as stated above. Here also it operates indirectly by setting free the oxygen of the water. This makes evident the necessity of adding moisture to the air; and it is found that, if the infected substances are also moistened, their sterilization is accomplished. The air of a warm room is seldom saturated with aqueous vapour, and unless it is, and unless the surfaces are cooler than the air, there will be little chance of any good result from the chlorine, as was pointed out in discussing the solubility of germicides.

The generation of chlorine in sufficient quantities for aerial disinfection is rather troublesome in private practice, and, besides, it is necessary in using it to observe proper precautions to prevent the ruining of all manner of metallic objects. It may also injure any cloth, carpet, or garment that derives its colour from vegetable dyes. The *chlorine water*, *aqua chlori* (U. S. Ph., Br. Ph.), is mainly used for bleaching purposes; if it is employed as a disinfectant, there should be a quantity sufficient for the complete immersion of the articles with considerable unoccupied fluid on all

* For the statements and directions regarding the use of the individual germicides, the author has taken as his main authority Surgeon-General George M. Sternberg, of the army, whose recent publications on this subject are the best in the English language.

sides of them; and the exposure should be of two or three hours' duration.

As an *internal* remedy for zymotic diseases, we can not consider that its value has been proved, but as an *external application* in the treatment of *ulcers*, *gangrene*, etc., there can be no doubt of its efficacy. When it is so used, the dressing must be covered with something that is impenetrable by the air, so as to prevent its too rapid evaporation. A *chlorinated oil*, which is obtained by allowing chlorine gas to bubble through olive oil, is said to be a useful antiparasitic in such cutaneous diseases as owe their origin to mycelial infection.

Bromine is used for the local treatment of *hospital gangrene*, *putrid sores*, *erysipelas*, and *parasitic cutaneous diseases*. It was introduced into army practice during the War of the Rebellion, and its use in hospital gangrene gave far better results than had been attained up to that time. It was recommended on the strength of its oxidizing properties, the doctrine of the bacterial origin of disease being at that time in its theoretical stage. The principle, however, was essentially the same, as we use these agents in reality, not because there is a *contagium vivum*, but because we wish to destroy poisonous substances of organic origin. The only method by which bromine can be conveniently used is in solution, as *bromine water*, of the strength of about 1 to 1,000. According to Miquel's table, it is weaker than chlorine as a germicide, being "very strongly antiseptic" at a dilution of 1 to 1,666, while chlorine is equally potent at 1 to 4,000.

Iodine is a germicide which, as indicated by Dr. Sternberg's investigations, is capable in a 0·2-per-cent. solution (1 to 500) of destroying the micrococci of pus in two hours—not very energetic as compared with some others, but, as an *antiseptic*, of occasional use. It is to be found in almost every household, and may be classed among those drugs which are often very convenient for temporary use.

For instance, at the first visit to a case of *diphtheria*, if it should be important, on account of the foul state of the fauces or pharynx, to use some antiseptic or disinfectant immediately, tincture of iodine might be employed. If the patient can not use a gargle, the physician should prepare two swabs of absorbent cotton or clean, soft muslin, have one dry, and dip the other in the iodine, wetting only the distal third. While the mouth is held open, the dry swab is laid gently against the tonsil, not encroaching on the tongue or pharynx, first on one side and then on the other, so as to soak up as much material as possible. Then the iodine is applied by the same manipulation. If this is done quickly, it may not cause any retching, and will temporarily purify the region. All the apparatus should be burned at once. The vapour of iodine is not of much service.

Iodoform is not a germicide, but may, through the medium of its liberated iodine, act antiseptically and prevent the development of germs.

The supposed beneficial effects of iodoform on *ulcerated throats* must, if actually obtained, be due to some other medicinal property than a germicidal one, as the known properties of the drug, particularly its very slow action, exclude any germicidal action. To insure that action it is necessary that the contact should be prolonged.

Iodine terchloride (ICl_3) has been found experimentally to be one of the most powerful of germicides. Professor Behring, who has recently electrified the medical world by his researches in diphtheria, found that a 1-per-cent. solution destroyed the anthrax spore (one of the most resistant of disease germs) almost instantaneously; and a 0·2-per-cent. solution did the same thing in "a few minutes." This was in water, and under the most favourable circumstances. But when they were suspended in blood serum a 1-per-cent. solution of iodine terchloride destroyed them in forty minutes. This is a recent addition to our list of germicides, and there has not, as yet, been sufficient investigation to warrant me in doing more than calling attention to it.

Hydrogen peroxide (H_2O_4) has very great deodorizing and germicidal properties. The attraction which binds together the component atoms is, to speak figuratively, under great strain, the elements, under ordinary circumstances, tending to unite in a different proportion—namely, 2 parts of hydrogen to 1 part of oxygen, H_2O; and, in the presence of other elements whose affinity for oxygen is not satisfied, the peroxide is decomposed without the application of heat or any other force, and the oxygen enters into new combinations.

When organic bodies containing carbon are attacked, carbonic oxide is liberated, and escapes so rapidly that there is active effervescence.

As a general disinfectant hydrogen peroxide is not equal to many others which are cheaper and more easily managed.

Ozone, or *triatomic oxygen*, is, theoretically, a powerful disinfectant, and is stated so to be in the systematic works on chemistry. This belief arose from the observation by chemists of its great oxidizing energy.

This was, however, largely the result of experiments in inorganic chemistry and on dead organic matter. The exact researches of the bacteriologists have shown that in their field it ranks low. Besides, it is not available practically, as it requires elaborate processes for its production, and is not easy of manipulation.

When there is much organic matter present the energy of ozone is largely expended in its oxidation and the bacteria or spores may escape. In laboratory experiments its action is found to be rather slow, even when the cultures are diluted with water.

This destruction of organic matter is itself useful and has led to the employment of ozone in *diphtheria* to decompose and remove the false membrane and at the same time destroy the pathogenic bacteria. The latter result is doubtful, however, for the ozone is not retained on the surface of the mucous membrane long enough to complete its work. It is also used in solution to inject *sinuses* and such bone cavities as the antrum of Highmore; but this

must not be done without first securing a free orifice for the gas, which is generated with such rapidity that, in the absence of a free vent, it causes excruciating pain. Indeed, it is a great objection to the use of peroxide of hydrogen in such cases that it causes excessive pain. The writer has found it no better than a number of other things that are not open to this objection.

Potassium permanganate is an old remedy in the surgical wards, although its place is rather low on the list to-day. In this matter we can not for a moment doubt the reliability of the results published by scientific observers. The investigations are of a character which admits of certainty in their results when carried by those specially trained for the work.

Permanganate of potassium has one great disadvantage—namely, its staining of textile fabrics. Nevertheless, as a wash for *ulcers, unhealthy wounds*, and the female genitalia, it is as useful now as before.

It promotes healing, apparently, aside from its antiseptic influence. For exclusive antiseptic purposes, however, it should, I think, be regarded as one of the makeshift substances, to be remembered when the more potent ones are not available.

Acids.—*Sulphurous acid* is made by dissolving sulphur dioxide or sulphurous oxide (SO_2) in water, and is officially a solution of sulphurous acid (H_2SO_3) in water, of the strength, in the U. S. Ph., of 3·5 per cent., while in Great Britain it is 9·2 per cent.

The product of the combustion of sulphur is SO_2, or sulphur dioxide, and is what we get from the burning of sulphur in the popular method of disinfection. This dry gas has no disinfectant properties, so far as we know; but, fortunately, in the presence of a moist atmosphere and, still more, when it is dissolved in water, it is efficient; the water and sulphurous oxide are mutually decomposed and the constituents of a molecule of each, uniting, give us sulphurous acid, H_2SO_3. The value of our operation, then, will depend not only on the amount of sulphur burned, but also on the amount of water which we vapourize in the room. However, as I have already explained, there is no necessity of such a process if the walls and floor and the contents of the room are scrubbed with a disinfectant solution, and if the air is thoroughly changed.

In order to disinfect a room of ordinary size (140 to 200 sq. ft. in its horizontal area) 2 or 3 pounds of sulphur should be burned, and everything in the room should be thoroughly wet, as well as the floor, ceiling, and walls. Wetting everything beforehand is more convenient and much more effectual, if well done, than boiling water to moisten the atmosphere.

It is necessary, also, to raise a board from the floor, so that the gas may penetrate beneath it. If there is a carpet on the floor, it should be left there, and enough water sprinkled on to it from a watering pot to wet it through and through, because the carpet is the most dangerous object, excepting the bed, that the room contains.

The germicidal properties of sulphur dioxide are also reported to be of use in the direct treatment of at least one zymotic disease—namely, whooping-cough.

The plan is to burn sulphur in the room in which the child is to sleep, the bed being made up beforehand, and thrown open so as to allow free access to the fumes. Any one who has slept in a bed which has been so exposed will remember the strong sulphurous odour of the coverings and pillow, and the "sticky" feeling of the sheet and pillow case. This treatment is said to have a decided curative effect. It must, however, exert only an antiseptic influence if any, as it would be too weak for actual disinfection. It may be that it is beneficial on account of an effect on the mucous membranes, or the terminations of the olfactory nerves.

Sulphuric acid is an effective germicide if the solution employed is strong enough, but not having any special selective action, apparently, it must be made of such strength that it is too corrosive for use, excepting in cesspools, sewers, and non-metallic drains.

In Boer's experiments (Sternberg), he found that cultures of bacteria twenty-four hours old, exposed to the action of diluted sulphuric acid for two hours, were killed by solutions of varying strength as follows: For anthrax bacilli without spores (the spores being much more resistant than the bacilli), 1:1,300; diphtheria bacillus, 1:700; glanders bacillus, 1:200; typhoid bacillus, 1:300; cholera spirillum, 1:1,300.

Hydrochloric acid, HCl, in Boer's experiments gave almost exactly the same results as sulphuric acid.

Nitric acid, HNO_3, is not so active a germicide as the two preceding. Those two—sulphuric and hydrochloric—are recommended by Dr. Sternberg for the disinfection of excreta, a 4-per-cent. solution added to an equal quantity of the matter to be sterilized.

Phosphoric acid, PO_4H_3, is rather more active than the three preceding ones. It would, however, be rather expensive for use in large quantities, as, although it was found to be fatal to typhoid bacilli in a 0·3-per-cent. solution, to be safe with the discharges of patients with contagious diseases it should be used as strong as 4 per cent.

The following acids are of about the same potency as those already named: Nitrous acid, lactic acid, acetic acid, citric acid, oxalic acid, and chromic acid.

Boric and salicylic acids are weaker, and the latter is only very sparingly soluble.

Tannic acid seems to be rather more active and to be fatal to a larger number of bacilli, but its capacity for staining is a great disadvantage. It may be used for discharges in a 2- or 3-per-cent. solution. Tannic acid is one of our most valuable remedial agents in *diseases of the nose and throat*, on account of its antiseptic or disinfectant properties, besides which it appears to have a specific action of its own on the mucous glands. In cases of *disease of the tonsillar follicles*, in which their secretion is retained and undergoes putrefaction, a spray of a 1-to-5-per-cent. aqueous solu-

tion of tannin, with glycerin, thrown forcibly into the follicles will cleanse them and have an antiseptic effect, so that they will tend to return to their normal condition if the general health is good. But we should not overlook the danger that the astringency of the tannic acid may, by causing coagulation, provide a barrier against its own germicidal operations upon any bacilli which are inclosed in the coagula. For this reason it is not serviceable as a dressing for wounds or sores as it is in the preliminary cleansing of their surfaces.

Alkalies.—*Calcium oxide*, CaO, the calx of the U. S. Ph., commonly called *lime*, though classed among the alkalies and the most important of the alkaline earths, has qualities which, as a germicide, make it unique.

When brought into contact with organic compounds, it acts upon them in three ways: First, by absorbing water from them; second, by the liberation of energy in the form of heat; and third, by the decomposition brought about in animal and vegetable bodies by the strong affinities of its over-component atoms. The last is spoken of in general terms as its caustic action.

The alkali, by its attraction for the fatty matters, particularly the oxygen for saline and albuminous bodies, and both of them through their reactions with the salts of various kinds, brings about, with the aid of the displacement of water and the generation of heat, the most complete chemical metamorphosis.*

This substance is known also as quicklime because of the active discharge of air from its pores as it is displaced by the water absorbed. The heat liberated is sufficient to raise the temperature to 350° F.

The presence of albuminous matter does not interfere with the action of this disinfectant.

Milk of lime is made by adding slaked lime to water until the mixture has a milky colour and consistence. Dr. Sternberg recommends that it be made of the strength of 1 part of lime to 8 parts of water.

Lime, while a reliable germicide, is a slowly acting one, and on that account it is more useful for latrines than for the disinfection of the refuse of the sickroom.

Potash, or potassa, is not a very powerful germicide, but may be used for the sterilization of excrements when lime is not at hand.

Soda, NaOH, the chemical analogue of potash, is of about the same character and standing as a germicide.

Compounds of the metals—viz., zinc, mercury, copper, iron, silver, gold, and arsenic—are used more than any other class of germicides in surgical practice, with the exception of phenol or carbolic acid. Three of their number are superior to all other known antiseptic or disinfectant agents. These are corrosive sublimate, iodide of mercury, and nitrate of silver.

Bichloride of mercury is the most generally useful of all germicides. The nitrate of silver alone exceeds it in the power to kill pathogenic germs in very weak dilutions, but its staining property and its expense greatly diminish its "all round" availability. Dr. Sternberg, in the report of the committee on disinfectants of the American Public Health Association, says: "Mercuric chloride, in aqueous solution, in the proportion of 1 to 10,000, is a reliable agent for the destruction of micrococci and bacilli in active growth, not containing spores; and in the proportion of 1 to 1,000 it destroys the spores of bacilli, provided that the microorganisms to be destroyed are fairly exposed to its action for a sufficient length of time."

To kill the spores of such bacteria as those of tuberculosis and anthrax requires a 1-to-1,000 solution at least, but their development is checked by solutions of exceeding tenuity. The adjective "aqueous" in the foregoing quotation is very significant. It relates to the fact that the presence of albuminous bodies impedes the action of the mercuric chloride, which, by coagulation and the formation of an albuminate of mercury, shields the inclosed bacteria and prevents the access of the germicide to them. The actinic rays of the solar beam also decompose the solution slowly. The addition, however, of the chloride of sodium or chloride of ammonium, or of 5 parts of hydrochloric acid to 1 part of the bichloride, is said to exclude the force of these decomposing agents.

As it does not stain, corrosive sublimate is very extensively used for the disinfection of clothing, bedding, and the walls, ceiling, and floors of rooms. It will, however, *decolourize* many of the dyed textile fabrics, although it does not stain them.

For those purposes of which I spoke in the early part of this article—viz., the disinfection of rooms and of linen which is soiled by the discharges of patients with contagious maladies—the solution should not be weaker than 1 to 1,000, and 1 to 500 would be safer. For the cleansing of wounds and ulcers a strength of 1 to 3,000 is enough, but the solution should be freely used and, if possible, thrown with some force against the surface.

The solution used in surgical operations is about 1 to 3,000; but for the vessel in which instruments are laid it should be 1 to 100.

A very important matter, and one frequently if not almost generally overlooked, is the *length of time* required for disinfection, and even for the less intense operation of antisepsis. No doubt many of the failures in antiseptic surgery have been due to the fact that pathogenic bacteria in the wound, dressing, or tissues have not been sufficiently long under the influence of the germicides employed. It is a legitimate inference that the fluids used in operating should be as strong as is possible without devitalizing the tissues.

Biniodide of mercury is the analogue of the bichloride, and the remarks on that substance may be applied to this one.

Nitrate of Silver.—The investigations of Behring have shown that nitrate of silver is of greater germicidal power, as tested by cultures in blood serum, than even bichloride of mercury. Its action is not interfered with to the

* Bernatzik, in Eulenburg's *Realencyclopädie der ges. Heilk*, iii, p. 604.

same extent by the presence of other albuminous solutions.

The development of anthrax spores in blood serum was found to be prevented by a 1-to-40,000 aqueous solution, and the same spores were killed in seventy hours by a 1-to-12,000 solution. Anthrax bacilli in blood serum were killed in twenty hours by a 1-to-5,000 solution (Sternberg). This shows the wonderful potency of this salt, which would be oftener used were it not for its expensiveness and its staining properties.

Ferrous Sulphate.—This salt is mentioned here because of its having long been ranked among the efficient disinfectants, and in order to call attention to the results of more modern researches, which have shown that, while it is a good deodorizer, it is of no practical use as a germicide.

Sulphate of copper is a useful germicide, but only within a pretty narrow sphere. Its use is much restricted on account of its inability to destroy bacteria if they are in albuminous liquids—that is to say, to destroy *all* the bacteria that are present in a given solution. In other words, it does not *sterilize* such a solution, and this because the flocculi of the albuminous precipitate shield the bacteria which they contain from its attack. Its other peculiarity is that it does not kill the spores of the bacteria. The practical inference from this is that we can not rely upon sulphate of copper for antisepsis or disinfection when we have to deal with spore-bearing pathogenic micro-organisms. Dr. Sternberg advises a 1-per-cent. solution.

Sulphate of zinc is, like sulphate of iron, noted here because it has been popularly supposed to be a good disinfectant. Modern experimental bacteriology has found it practically useless for that purpose.

Coal-tar Products.—There are three of these which are reliable disinfectants—viz., carbolic acid, cresol, and creolin.

Carbolic acid, or *phenol*, is one of the secondary aromatic alcohols. To insure against error, it is safer in ordering it for disinfection to use the term *phenol*, as the crude carbolic acid is often used for that purpose on account of its cheapness. The latter, however, is only one fourth as strong as the pure crystalline drug.

The physician should always, I think, give very definite directions for putting this drug in some place which will make it absolutely sure that no mistake can be made and the acid taken in the place of some remedy. It is such a dreadful poison—not merely fatal, but fatal only after the most agonizing pain—and these mistakes are so frequent, carbolic acid being swallowed by mistake oftener, probably, than any other poison, that it behooves the practitioner to warn and direct the people in regard to it.

Carbolic acid, so far as concerns the length of time and the strength of the solution required for its germicidal operation, does not rank high as compared with some of the metallic salts, but it has the advantage of not being impeded in its action by the presence of organic matters, it is more stable, and it does not injure or corrode instruments.

For the disinfection of excreta a 5-per-cent. solution equal in quantity to the volume to be disinfected should be allowed to stand on them for four hours.

Articles of clothing, etc., which are to be boiled may be put into a 1- or 2-per-cent. solution to prevent any multiplication of germs while one is waiting, and also have the disinfection started before they are put into the boiling water.

Creolin is another coal-tar compound (not known to be a definite chemical substance). It is more selective in its action than phenol, being much more effective with some bacteria than with others, and is resisted by spores. A great disadvantage is that albuminous bodies interfere with its work. When spores are not to be dealt with, it may be used in the strength of from 2 to 4 per cent. It emulsifies in water on vigorous shaking.

Cresol is one of the secondary aromatic alcohols, and is coexistent with phenol in coal tar and pine pitch. It is not embarrassed in its action by albuminous bodies, it kills spores, and it is more deadly to the *Bacillus tuberculosis* than carbolic acid is. It is, however, too expensive for use in large quantities. It is emulsified in water by shaking, and the strength should be about the same as that of creolin.

Naphthol is antiseptic, but not a germicide. It is insoluble in cold water. It is used in the strength of about 1 per cent. as a wash, and for irrigation of wounds and the genito-urinary organs. But it is irritating, and is really of use only when other and better agents are not at hand.

Thymol, like many other drugs, seems to have had hitherto an undeserved reputation, for Behring found it only one quarter as strong as phenol.

In connection with this class of germicidal bodies it may be well to remark that, when used medicinally, either internally or topically, they have therapeutic effects quite distinct from their qualities as germicides. They undoubtedly exert an influence on the cells and tissues of the body, and are endowed with the same elective capacity as most other drugs are. Again, the very important therapeutic principle must not be overlooked that agents which have a tonic or restorative effect upon the cells, tissues, or organs may indirectly, by increasing their vital resistance, have a decided antiseptic influence. I will ask attention once more to the necessity of considering to what extent the solutions of our germicides will be reduced in strength in any given case by dilution with the fluids contained in the matter to be disinfected. Failure to allow for this is no doubt the cause of many of the unfortunate results witnessed from time to time.

Essential Oils.—It may be of interest to the reader for me to copy a table prepared by Cadéac and Meunier showing the time required respectively by a number of the essential oils to kill the bacillus of typhoid fever :

Oil of cinnamon	12	minutes.
" cloves	25	"
" thyme	35	"
" verbena	45	"
" geranium, French	50	"
" patchouli	80	"
" wormwood	4	hours.
" santal	12	"
" cedar	22	"

BENJAMIN F. WESTBROOK.

GIN.—This spirituous liquor may be used as a stimulant like brandy or whisky. It is much used as a domestic remedy for *dysmenorrhœa*, in the palliation of which it seems to have some virtue; its use for this purpose is to be countenanced only as an occasional expedient, and habitual recourse to it is to be discouraged.

GINGER, *zingiber* (U. S. Ph., Br. Ph.), *rhizoma zingiberis* (Ger. Ph.), is a carminative of considerable value in *colic*. The dose is from 15 to 30 grains, which may be stirred in a wineglassful of hot water. The dose of the tincture, *tinctura zingiberis* (U. S. Ph., Br. Ph., Ger. Ph.), is from 15 to 60 minims; that of a stronger tincture, *tinctura zingiberis fortior* (Br. Ph.), commonly called "essence of ginger," is from 5 to 20 minims. The dose of the fluid extract, *extractum zingiberis fluidum* (U. S. Ph.), is from 10 to 30 minims; that of the oleo-resin, *oleoresina zingiberis* (U. S. Ph.), is from 2 to 5 minims. The syrup, *syrupus zingiberis* (U. S. Ph., Br. Ph., the two differing widely in the method of their preparation), may be used to flavour mixtures, to the amount of a teaspoonful to each dose of the mixture. Troches of ginger, *trochisci zingiberis* (U. S. Ph.), may be of some service in *catarrhal affections of the mouth* and *throat* by virtue of their topical action when allowed to dissolve slowly in the mouth, and they are a convenient preparation for internal use.

GLACIALIN.—The *glyceritum boroglycerini* described under BORIC ACID.

GLONOIN.—See NITROGLYCERIN.

GLUCOSIDES.—See under ACTIVE PRINCIPLES.

GLUCO-CHLORAL.—See CHLORALOSE.

GLUE.—This substance has been used for making rigid splints of pliable material, but for that purpose it is not very valuable, as the splints are apt to become softened by liquids; moreover, glue, being an easily decomposed substance, is unsuitable when a purulent discharge may come in contact with it. It possesses the advantage of being readily obtained in nearly all localities, and where nothing more suitable was at hand would be very useful in tiding over an emergency. The best glue should be somewhat translucent, and may vary in colour from a light gray to a yellowish brown; it should be hard and dry, and present a glassy fracture. Cold water should not dissolve it, but cause it to swell to two or three times its bulk. Water at the temperature of about 150° F. should completely dissolve it. In preparing it for use it is not safe to dissolve it by direct heat, but the vessel containing it should be placed in another containing hot water. Sufficient water must be added to form, when heated, a fluid but little thicker than water, as otherwise it is difficult to handle and is apt to set too rapidly. When it is to be employed in making splints about a fifth of its bulk of alcohol should be added immediately before using it, for the purpose of assisting its absorption by the bandages and to hasten the evaporation of the water. Before it is applied the part to be dressed must be lightly greased for some distance beyond the confines of the bandage when finished, and a layer of soft lint placed next to the skin. Over this an ordinary roller bandage is applied, and the glue is painted over each layer of the cloth. From three to four turns will be sufficient for it to dry in most cases, and only as much glue should be used as will thoroughly saturate the cloth. If moisture is kept from it and no severe strain put upon it, it will be fairly useful. By adding to glue, dissolved in water, about its own weight of glycerin and driving off the water by heat a compound is formed from which elastic and permanent models or casts may be made, all that is necessary to do being to melt it and pour it into the mould or upon the part of which the cast is to be taken. By it intricate casts may be made, as their elasticity allows of their easy removal. A good liquid glue which can be used cold may be made by dissolving 4 parts of glue in 10 of acetic acid. Waterproof glues are made by the addition of small amounts of potassium bichromate and exposing the bodies cemented together to the action of the sunlight for several hours.

[Glue, cut roughly into pieces shaped like a suppository and then allowed to soften and swell in cold water, so that it can readily and safely be inserted into the rectum, has been used as a suppository in the treatment of *habitual constipation*, in which it acts in a manner very similar to that of a glycerin suppository.]—RUSSELL H. NEVINS.

GLUSIDE.—See SACCHARIN.

GLUTEN.—This nitrogenous constituent of wheat, in which it exists in the proportion of from 8 to 15 per cent., is made up of a number of albuminoids differing chemically and physically from each other in only a slight degree. It gives to wheat its high value as a food, and also attracts notice from the fact that it has been used to a considerable extent as a substitute for ordinary flour in the making of bread, etc., for those affected with *diabetes mellitus*. It is generally obtainable in nearly all the larger towns and cities, but may be prepared by repeated and long-continued washing of wheat flour in a cloth bag. In ordinary fresh bread the crust contains a considerably larger portion than the crumb, and is consequently better for diabetics than the latter. As found in commerce, gluten flour contains a large amount of starch, anywhere from 60 to 70 per cent., for which due allowance must be made in marking out a diabetic dietary. Porridge, bread, biscuits, etc., may be made from it as from ordinary flour, but it

is desirable to use milk instead of water, and to add eggs. As a rule, diabetics relish these preparations for a short time only, and they have little or no real therapeutic value. They present the appearance of bread, etc., and resemble it in taste to a certain extent, but are insipid and soon excite disgust.

Gluten has been suggested as a substitute for albumen in poisoning by corrosive salts, but is not so effectual or so readily obtained.

. Russell H. Nevins.

GLUTIN-PEPTONE SUBLIMATE.—This German proprietary compound, called by Dr. Cerna "a hydrochlorated glutino-peptonate of mercury," is said to contain 25 per cent. of corrosive sublimate, to occur as a white hygroscopic powder (generally furnished in a 1-per-cent. solution), and to be but moderately irritating when used hypodermically, so that it does not produce abscesses. It has been used in the treatment of *syphilis* in daily amounts of a Pravaz syringeful of the 1-per-cent. solution.

GLYCELÆUM.— This is an ointment basis made of 1 part of fine almond meal, 2 parts of glycerin, and 6 parts of olive oil.

GLYCERATES, GLYCERIDES.—See Glycerites.

GLYCERIN, *glycerinum* (U. S. Ph., Br. Ph., Ger. Ph.), applied locally to the skin or to mucous surfaces, is slightly irritating and stimulates secretion, the fluids excreted being absorbed by the glycerin. While *antiseptic* properties have been ascribed to it, Koch's experiments show that it does not destroy the spores of micro-organisms, although a solution of 1 part in 3 parts of water arrests the action of pepsin, ptyalin, and some other enzymes, and a solution of 1 part in 2 parts of water prevents the action of other enzymes, such as diastase, invertin, etc.; the glycerin is a preservative menstruum, and the enzymes act normally when removed from it.

The experiments of Lebedeff, Filehne, and Schwan show that when glycerin is injected beneath the skin of rabbits it causes hæmoglobinuria, a result that has followed the administration of large doses of glycerin by the mouth. Injected intravenously, glycerin has not caused hæmoglobinuria, or that condition occurred only in a slight degree. Pfannenstiel states that the hæmoglobinuria produced by glycerin causes a glomerulo-nephritis that may eventually pass on to an interstitial nephritis.

Internally, in small doses, glycerin is absorbed unchanged by the stomach, by means of the lymphatics, especially those passing between the stomach and the hilum of the liver and gall bladder. It possesses slight *cholagogue* properties, whence it has a moderate *laxative* action and may affect the excretion of urea, which it has been supposed to lessen, although Lewin has not found that it influences urea elimination. Apparently it augments the quantity of glycogen contained in the liver, and this would seem to indicate its value in diabetes mellitus, but Pavy has found that it increases polyuria, so it should not be administered in that disease. Its prolonged administration experimentally has caused interstitial hepatitis in animals.

Glycerin is popularly employed as an agent to prevent *chapping of the hands* or *lips*. For this purpose it is best used mixed with rose-water, in the proportion of 1 part to 3 parts, a few drops of carbolic acid being added to the mixture.

Associated with other medicaments, it is a useful application in *acne*, *eczema*, *fissures*, *psoriasis*, and *pruritus*. It increases the flexibility of collodion, and, added to it in the proportion of 0·5 per cent., it forms an elastic collodion. Bienert states that strips of linen or lint soaked with glycerin and applied to *burns* relieve the pain and prevent the formation of blisters. Cotton soaked with glycerin may be used in *abnormal dryness of the external auditory canal*, and the drug may be injected into the canal to dislodge *impacted cerumen*.

Sir Andrew Clark recommended applications of glycerin with carbolic acid in *hay-fever;* and this is a useful application in *acute coryza*, *acute pharyngitis*, and *amygdalitis*; the carbolic acid acts as a local antiseptic, and the glycerin produces local depletion. The mixture may be employed as a spray or a gargle, or it may be brushed over the surface; the less it is diluted the more efficacious is its action.

In treating *chronic cystitis* in women, Dr. Thomas More Madden, of Dublin, has advised forcible dilatation of the urethra and applications of glycerin with carbolic acid to the surface of the bladder.

One of the most valuable uses of glycerin is its application by means of a tampon or suppository to the cervix uteri and the circumuterine portion of the vagina, in *uterine congestion, dysmenorrhœa, endotrachelitis, endometritis, pelvic cellulitis*, and *salpingitis*. Its use should be preceded, when possible, by copious vaginal irrigation with hot water, and the tampon should be made of ordinary rather than of absorbent cotton, sufficiently large to dilate the upper portion of the vagina and carry a large quantity of glycerin. The tampons should be changed from three to four times a day, as their use produces an abundant serous transudation which gradually dilutes the glycerin and interferes with the desired action.

Pelzer has called attention to the value of glycerin intra-uterine injections as an oxytocic in simple *atony of the uterus* and in *placenta prævia*. Pains commence, on an average, in two hours after the injection of from 1 to 1½ fl. oz., and in from eight to ten hours the os is completely dilated, except in some cases of contracted pelvis. Pfannenstiel and Embden have reported what they believed were disastrous results consequent upon the employment of the method, hæmoglobinuria occurring in their cases, three in number, though no such symptoms followed in a larger number of cases treated by Pelzer and others.

In *constipation*, *hæmorrhoids*, *ulcer of the rectum*, and *anal fissure* an injection of from 1 to 4 fl. drachms of glycerin acts as a local lubricant and depletive, and causes evacuation

of the lower bowel. The injection should be retained for a few moments, so as to further the serous osmosis from the rectal veins, and the remedy should be administered by means of a short, blunt-nozzled syringe. The addition of from 0·5 to 1 per cent. of carbolic acid increases the efficacy of the glycerin. Glycerin suppositories are less efficacious, because they dissolve but slowly, and they act as foreign bodies; where they fail, the glycerin injections will succeed.

Professor Roberts Bartholow recommends an enema composed of 1 part of glycerin and 4 parts of flaxseed infusion to allay the tenesmus of *acute dysentery.*

Fæcal impaction has been relieved by the injection of several ounces of glycerin into the colon by means of the long rectal tube; this local action may be furthered by administering the remedy internally.

The dry tongue of *typhoid* and other *continued fevers* may by relieved by occasionally moistening it with a mixture of equal parts of glycerin and water; this mixture is a useful application to the dry tongue of advanced phthisis.

Internally, glycerin has been administered for the relief of *flatulence* and *heartburn*, and in *dyspepsia* due to insufficient excretion of gastric juice the glycerite of pepsin is of advantage. It is a laxative that may be used for *constipation in children*, and for *inflamed and painful hæmorrhoids* in adults.

Ferrand found that as a cholagogue it was a valuable remedy, in doses of from 5 to 7½ fl. drachms, in *hepatic colic*, bringing the attacks to an end; while doses of from 1¼ to 3¾ fl. drachms daily, in a little alkaline water, prevented recurrences of that complaint. He did not consider that it was a lithontriptic, but thought it was a good remedy for *biliary lithiasis.*

While it has been recommended as a substitute for cod-liver oil in the treatment of *tuberculosis*, it is far inferior to that remedy. It is said to be one of the best agents that can be used for the treatment of *trichiniasis.*

Samuel T. Armstrong.

GLYCERINES, GLYCERITES, GLYCEROLES, *glycerita* (U. S. Ph.), *glycerina* (Br. Ph.), are solutions of medicinal substances in glycerin, with or without water, extracts made with glycerin, or mixtures of glycerin with other substances. Examples of the glycerites that are solutions are *glyceritum acidi carbolici* (U. S. Ph. [*glycerinum acidi carbolici* (Br. Ph.)], *glycerinum acidi gallici* (Br. Ph.), *glyceritum acidi tannici* (U. S. Ph. [*glycerinum acidi tannici* Br. Ph.]), *glycerinum aluminis* (Br. Ph.), *glycerinum boracis* (Br. Ph.), *glyceritum boroglycerini* (U. S. Ph.); a glycerite that is an extract is *glyceritum hydrastis* (U. S. Ph.); and the official glycerites that are mixtures are *glyceritum amyli* (U. S. Ph. [*glycerinum amyli* (Br. Ph.]), *glycerinum plumbi subacetatis* (Br. Ph.), *glycerinum tragacanthæ* (Br. Ph.), and *glyceritum vitelli* (U. S. Ph.).

GLYCERYL NITRATE.—See Nitroglycerin.

GLYCONIN.—The *glyceritum vitelli* of the U. S. Ph. See under Emulsions (p. 376).

GLYCOZONE.—An American proprietary preparation, made by the action of ozone on glycerin, used like hydrogen dioxide.

GLYCYRRHIZA.—See Licorice.

GLYCYRRHIZINUM AMMONIATUM (U. S. Ph.), or *ammonium glycyrrhizate*, is a crystalline product, readily soluble in water. It is somewhat sweeter than many specimens of licorice, and may be used as a flavour instead of the extract, in such amounts that from 5 to 10 grains shall be contained in each dose of the mixture prescribed.

GNAPHALIUM.—A genus of herbs of the *Corymbiferæ.* Various species are used as pectorals. *Gnaphalium americanum* (*Anaphalis margaritacea*) is occasionally used as a vulnerary and as a remedy for *diarrhœa* and *dysentery.*

GOA POWDER.—See under Chrysarobin.

GOLD.—The metallic element gold (*aurum*) is one of the most ancient medicines. Pliny, in the first century, recorded its use as a recognised remedy for several conditions in which it is still employed, and it was highly esteemed as a medicament by Avicenna and other Arabian physicians, also by Dioscorides and Paracelsus. It was used as an antisyphilitic in the seventeenth and eighteenth centuries by Colle, Campi, Glauber, Pitcairn, Plencik, Gmelin, and others. In 1811 Dr. Chrestien advocated its employment in venereal diseases and affections of the lymphatic system, in which he was followed by Niel, Legrand, Gozzi, and many other European syphilographers, who formed the school of so-called "auralists," which revolted from the notorious abuse of mercury in syphilitic diseases during the second decade of the present century. In the United States and England it never obtained much professional favour, except in the hands of Mitchill and Delafield, of New York (1812–1820), who used it successfully in *syphilis* and *dropsy.* Professor Barton, of Jefferson Medical College, Philadelphia (1827), pronounced the following judgment upon it in his lectures on materia medica: "On the whole view of what has been said in favour of gold, I am not inclined to attach great importance to it as a remedy. It is well enough in its proper place and for its proper purposes, for which it is more useful than as a medicine. Plenty of it would doubtless cure many diseases of mind and body." Such has been the general professional opinion since, but of late years a number of compounds of gold with other elements (chlorine, bromine, iodine, arsenic, and mercury) have been employed with considerable satisfaction as medicaments.

There is only one official preparation, viz., gold and sodium chloride, *auri et sodii chloridum* (U. S. Ph.), *auronatrium chloratum* (Ger. Ph.). Fine gold and a solution of the perchloride are placed in the appendix to the Br. Ph. Powdered gold, also the oxide, chloride, sodiochloride, iodide, and cyanide are official in the Fr. Cod.

Auri pulvis, powdered gold, may be obtained by triturating gold leaf with ten times its weight of potassium sulphate or sugar of milk until brilliant particles are no longer visible, and then washing the diluent away with boiling water. A trituration of gold may be prepared in the same manner, retaining the diluent sugar of milk, as directed by the pharmacopœia under the title Triturationes. The dose of powdered gold is from $\frac{1}{6}$ to 1 grain, or it may be applied by friction to the sides of the tongue.

Auri chloridum, gold chloride, or perchloride (terchloride) of gold, the "potable gold" of the alchemists, $AuCl_3$, occurs in needle-shaped prisms, of a deep orange-yellow colour, which are very deliquescent and freely soluble in water, in alcohol, and in ether. The dose is from $\frac{1}{60}$ to $\frac{1}{30}$ of a grain, in pill or solution, preferably the latter. The commercial salt so much used by photographers is not the pure chloride, but a crystallized double salt of gold and sodium, $AuCl_3NaCl_2.H_2O$, containing 50 per cent. of metallic gold (Squire).

Auri et sodii chloridum (U. S. Ph.), gold and sodium chloride, is a mixture of equal parts, by weight, of dry gold chloride, $AuCl_3$, and sodium chloride, NaCl, occurring as an orange-yellow powder, odourless, of saline and metallic taste, slightly deliquescent in damp air, very soluble in water, but only partly so in alcohol. It contains about 32 per cent. of pure gold. Its aqueous solution has a faintly acid reaction, and its solutions are decomposed by organic substances, by most salts, and by light. The commercial salt is the commercial gold chloride (see above) mixed with an equal weight of sodium chloride, and contains 25 per cent. of metallic gold. The dose is from $\frac{1}{30}$ to $\frac{1}{5}$ of a grain, once or twice a day. The Ger. Ph. gives the maximum single dose as $\frac{3}{4}$ of a grain, and the maximum daily dose as 3 grains, but these are too high.

Auri peroxidum, gold peroxide, auric acid, Au_2O_3, occurs as a brown powder, insoluble in water, decomposed by exposure to light. The dose is $\frac{1}{10}$ of a grain twice or thrice a day.

Auri iodidum, gold iodide, AuI_3, is a greenish-yellow powder, insoluble in cold water, but slightly soluble in boiling water, soluble in a solution of potassium iodide. On exposure it loses iodine and is converted into yellow aurous iodide, AuI, and finally into metallic gold. Heat resolves it into iodine vapour and a residue of pure gold. The dose is from $\frac{1}{16}$ to $\frac{1}{8}$ of a grain twice or thrice daily.

Auri bromidum, gold bromide, $AuBr_3$, occurs as a yellowish-gray, friable mass, insoluble in water, soluble in ether, containing 55 per cent. of bromine. The dose is from $\frac{1}{20}$ to $\frac{1}{6}$ of a grain. Against *migraine* the minimum dose should be used twice daily, an hour before meals.

Auri et sodii bromidum, gold and sodium bromide, $AuBr_3NaBr.2H_2O$, may be used hypodermically in solution, 2 parts to 100 of distilled water, the dose of which is 8 minims increased to 32 minims.

Liquor auri et arseni bromidi, solution of gold and arsenic bromide (Barclay), has $\frac{1}{32}$ of a grain of each salt in 10 minims, and is marketed under the trade-name "arsenauro." The dose is from 5 to 15 minims in water, after each meal.

Liquor auri, arseni, et hydrargyri bromidi, solution of gold, arsenic, and mercury bromide (Barclay), has in each 10 minims $\frac{1}{32}$ of a grain of each salt, and is marketed under the trade-name "mercauro." The dose is from 5 to 10 minims in half a wineglassful of water, thrice daily, after meals. It should be dispensed in glass only.

The salts of gold are easily decomposed, and the chloride, like the chlorides of mercury, is incompatible with very many agents; so that gold salts are best administered by themselves, the insoluble salts in pill or powder, the soluble ones in simple solution in distilled water. They should not be prepared until wanted for use, and should be excluded from the action of light.

Physiological Action on Animals.—In frogs the salts of gold cause rapid paralysis of the central nervous system, apparently affecting first the optic lobes and the cerebellum, then the spinal cord, and lastly the cerebral lobes. In mammals small doses appear to increase the appetite, while larger ones give rise to symptoms of gastric and intestinal irritation, loss of appetite, diarrhœa, and emaciation, followed by paralysis of the limbs, catarrh of the respiratory passages, and death by asphyxia. Large doses injected into the veins cause œdema of the lungs and rapid death with convulsions from asphyxia (Brunton). Experiments with the chloride injected into the veins of dogs have resulted fatally within three or four minutes in some cases, with great dyspnœa, and the autopsies have shown the lungs of a livid hue, except for a few rose-coloured spots, and their structure dense, like liver, filled with blood, and non-crepitant, hardly floating in water, or remaining just below the surface. In other cases, where the salt was administered by the stomach, the animal did not die for several days, but grew lean and depressed; the stomach was found to be corroded or ulcerated, and the lungs were but slightly affected (Orfila).

Physiological Action on Man.—The action of the salts of gold upon the human organism is analogous in many respects to that of mercury, causing local irritation and escharotic effects when applied in substance or in strong solution. In continued medicinal doses given internally they produce a condition of general erethism which strongly resembles the mercuric fever, accompanied by salivation but without tenderness or ulceration of the gums. The chloride is one of the most active salts, being, according to Chrestien, even more toxic than corrosive sublimate. Locally, it produces irritant and caustic effects, imparting a yellow stain to the skin, which later on turns violet and even black, from reduction of the metal therein. In overdoses it causes gastric pain and inflammation and ulceration of the gastro-intestinal mucous membrane, and otherwise acts as a corrosive poison; toxic doses produce a violent gastro-enteritis, with such nervous

phenomena as convulsive tremor, cramps, priapism, insomnia, and insensibility (Magendie).

The salts of gold, administered in small medicinal doses, increase the appetite and the digestive power and stimulate the functional activity of the secreting organs, especially the skin and the kidneys; also the generative apparatus, causing diaphoresis and diuresis and exciting the menstrual flow in women and the sexual appetite in men.

Schepers (*Dissertio medica inaug. de auro*, etc., Univ. Groningen, 1838) summarized the observations of Chrestien, Niel, Zum Zobel, Delafield, and others as having established the power of these salts to excite the vascular and muscular systems and produce fever, to promote absorption, to increase the urine and the sweat, to cause salivation without stomatitis, a sense of heat in the stomach, headache, and diarrhœa, to promote menstruation, excite the genitalia, and profoundly affect the nervous system. Under larger or continued doses there are dryness of the tongue, redness of the pharynx, gastric and intestinal colic, nausea and vomiting, and even erosion of the gastric mucous membrane.

Antidotes and Antagonists.—Poisoning by gold salts is treated like that by corrosive sublimate. The antidote is albumen in some form, then evacuation of the stomach, as the albuminate is not wholly inactive. The antagonists are bismuth, tannin, sodium sulphite, and diluted nitric acid in water, as gargles and mouth-washes for salivation; belladonna, to lessen secretion in ptyalism; hyoscyamine for tremor; and morphine for shock.

Therapeutics.—The literature of gold shows that it was anciently of repute for the cure of lichenoid eruptions, fistula, hæmorrhoids, warts, putrid ulcers, and sores emitting an offensive smell (Pliny, A. D. 77). By the Arabian physicians and by the alchemists during the Middle Ages it was employed, in the finely divided metallic state, as a panacea. In the seventeenth and eighteenth centuries it was highly recommended by several authorities as an antisyphilitic, as well as for leprosy, dropsy, epilepsy, the pest, fevers, amenorrhœa, sterility, and uterine diseases. During the first quarter of the present century it was in high repute as a remedy for syphilis and scrofula among the continental physicians, as shown by the writings of Chrestien, Niel, Legrand, and others. Mitchill (1818) used it in the New York Hospital year after year for *syphilis* with admirable results. In his opinion "the muriate of gold will effect all that is achieved by the muriate of quicksilver, with incomparably less inconvenience to the patient, who gets well under the former without the hazard of a sore mouth or a salivation, and with very little wear and tear of constitution." Trousseau (1851) says that the happy results of gold in the treatment of venereal diseases are incontestable; and von Schroff, of Vienna (1868), gave it great praise for the restoration of a case of syphilis in which the strongest mercurials had failed to avert destruction of the nasal bones or the deep, spreading ulcers of the skin. Phillips (1894) says that in his own experience its efficacy is best seen in the later developments of syphilis, such as ulceration of the nose and larynx, cutaneous syphilides, hard nodes, etc.; also that it may especially be employed in long-standing cases with chronic periostitis, and when mercury has been already given to saturation. Piffard (1881) finds it unquestionably useful in the later stages of syphilis, and considers its best effects to be obtained from very small doses, $\frac{1}{65}$ of a grain or less, which he rarely continues for more than one or two weeks at a time. Several other observers have given it great praise as a remedy in constitutions which are broken down by the combined influence of syphilis and mercury, for syphilis in strumous subjects, and for the various manifestations of *scrofula*. Under its use the auric fever may develop, and the local affections for which it is administered may assume an aggravated intensity, and even new ones appear; but these phenomena do not call for the suspension of the remedy, for the disease retrogrades rapidly in a few days after they appear (Trousseau); and on lessening the dose pyrexia subsides and good effects are more conspicuous (Phillips).

Scrofulous ulcers, *lupus*, *ozœna*, *enlarged and indurated cervical glands*, and *hypertrophy of the tongue* with induration, are some of the strumous affections which have been recently reported as cured by the internal and local use of auric preparations. Gold has been credited with many cures of *cancer* of the uterus, mammæ, and tongue, but it is probable that such have really been cases of scrofulous ulceration (Phillips). *Squamous skin diseases*, the "dartres" of the older writers, are, next to syphilis, the most successful field for the action of gold (Trousseau). In cutaneous diseases it is used topically as well as internally.

Dropsy is one of the affections in which gold was anciently recommended, and in which modern therapeutists have found it efficient, especially in *ascites* due to chronic hepatic disease (Goetzner) or induration of the abdominal organs (Schroff); also in *post-scarlatinal dropsy* (Wendt, etc.) and *dropsy of the ovaries* (Martini).

Disorders of the female generative organs have proved amenable to gold when persistently employed. The chloride has been used as a caustic in *ulceration of the cervix uteri* (Récamier). *Amenorrhœa* due to torpor of the ovaries and *chronic metritis* with scanty menstruation are often benefited thereby, while *sterility* dependent on these states or due to coldness is more certainly cured by auric preparations than by any other merely medicinal means (Bartholow). The tendency to *habitual abortion* may be averted by the use of the chloride, which is also of great benefit for mental symptoms of hysterical character, especially when connected with uterine disease (Martini). Other writers highly commend gold in *suicidal melancholia*, *hypochondriasis* accompanying hepatic or testicular disease, in *decline of the sexual power in men*, and as a tonic for low-spirited, pining boys with undeveloped testes.

Nervous dyspepsia characterized by a red and glazed tongue, epigastric pain increased by food, and relaxation of the bowels after eating, is greatly relieved by the chloride in small doses ($\frac{1}{20}$ of a grain) thrice daily. *Catarrh of the duodenum and bile-ducts* and *jaundice* therefrom, as also *vertigo* and vertiginous sensations connected with gastric disorders or due to cerebral anæmia, are often removed by the salts of gold (Bartholow).

Sclerosis of internal organs, especially the liver and kidneys, may be retarded by the persistent use of gold and sodium chloride in doses of from $\frac{1}{30}$ to $\frac{1}{20}$ of a grain thrice daily (Bartholow). A solution of the bromides of gold and arsenic has been successfully employed for several years by Dr. Barclay, of Pittsburgh, and others, in the various diseases of which sclerosis is the chief factor, such as *cirrhosis of the liver* and *lungs*, *interstitial nephritis*, *atheroma* and *calcareous degeneration of the arteries*, *senile degenerative changes* and *neurotic disease*, *fibroid phthisis*, *locomotor ataxia*, etc., also in *cervical adenitis*, *arthritis deformans*, *syphilitic neuralgia* and *iritis*, *miliary tuberculosis*, *epilepsy*, *chronic neuritis*, *sciatica*, *chronic muscular rheumatism*, and *neurasthenia*. A combination of gold and arsenic (*auri arsenas*) was introduced by Chrestien and extensively employed by Dr. Massart in *cancer* and *phthisis*, with sufficient success to merit the approval of the medical societies of Lyons and Toulouse. It is said to be particularly serviceable in scrofulous affections, especially *lupus*, and to exercise a highly beneficial influence on *anæmia* and *chlorosis*.

Gold bromide, though containing only 55 per cent. of bromine, is found to be many times more active, weight for weight, than the ordinary bromides. According to Shtcherbak, in doses of from $\frac{1}{2}$ to 3 grains to the kilogramme of body weight, it depressed the cortical motor centres so much that the strongest electrical stimulation thereof failed to produce an epileptic seizure. By Rosenbach, Danillo, and others, it was employed in doses of from $\frac{1}{4}$ to $\frac{1}{2}$ a grain with decided benefit in obstinate cases of *epilepsy* and *hysteria*. Goubert used it for *migraine*, *epilepsy*, *chorea*, and *exophthalmic goître*, in daily doses of from $\frac{1}{8}$ to $\frac{1}{6}$ of a grain, continued until its characteristic headache was produced; and alleges for it greater efficacy in epilepsy than is possessed by any other bromide, and says also that it is better tolerated and does not induce the depression and emaciation or other pronounced symptoms of bromism. Professor Laufenauer has tested a gold and sodium bromide, and finds it to be a valuable antepileptic remedy.

A so-called "bichloride-of-gold cure" for *inebriety* has lately become notorious through extensive advertising, but from the most reliable information obtainable it is reasonably certain that the salts of gold play a very subordinate part therein. The physiological symptoms produced by the hypodermic injection employed are those of strychnine and atropine, which, administered several times daily for weeks, have been followed in a large number of cases by insanity and other serious psychoses.

[At a meeting of the Mississippi Valley Medical Association held in September, 1895, Dr. Thomas Hunt Stucky, of Louisville, reported cases that in his judgment showed conclusively that the combinations of gold and arsenic acted as neither of these minerals did when administered separately. He believed that the action of the combination of bromide of gold and arsenic was entirely different from that of any other therapeutic agent known. As compared with mercury, iodine, or the combinations of iodides, the action of gold in the combinations named was intensified; these combinations entered into the circulation as gold and arsenic, and spent their force and exerted their influence in an alterative way upon the glandular system; a marked alterative effect was exerted upon all non-malignant scleroses; it was not only a blood-maker, but a blood-builder; it not only increased the number but improved the quality of the corpuscles; under its use hæmoglobin was decidedly increased; it was eliminated by the kidneys; and it produced no irritation when given either by the mouth or hypodermically.

Dr. G. Frank Lydston, of Chicago, reports that he has found "mercauro" of great value in the treatment of the late manifestations of *syphilis*, particularly those affecting the nervous system; also that he considers "arsenauro" far superior to the ordinary chloride of gold and sodium as a nerve tonic.] SAMUEL O. L. POTTER.

GOOSE GREASE, *adeps anserinus*, *adeps* (or *oleum*) *anseris*, was formerly used in pharmacy, and is still employed, both externally and internally, as a domestic remedy. Mr. Langford Symes (*Dublin Jour. of Med. Sci.*, June, 1895) says of it:

"That this substance possesses valuable medicinal properties is beyond question. In *affections of the chest* it is a most excellent substance to apply alone. In *bronchitis* of the subchronic type, or in moderate *catarrh*, few liniments or other applications will be found to equal this *oleum anseris*, or goose grease. If a drachm or two of this grease is placed in the hand and a stimulating liniment poured thereon and rubbed on the skin, it will be carried into the tissues in a remarkable way."

During an *influenza* epidemic the author frequently observed patients who were using this remedy for the cough, and noticed that they obtained benefit from its use. Where some bronchial trouble remains unresolved in the lungs, and that peculiar tenacious viscid secretion lies attached to its internal mucous vesicular wall, a stimulating liniment will be greatly helped, he says, by the addition of this grease. The liniment becomes much easier to rub in and appears to be more rapidly absorbed.

Mr. Symes relates the following case as an illustration: A gentleman was suffering with influenza of a "chronic" type. He was never ill enough to stay in bed, and scarcely well enough to be out. He had a dry hacking cough for many days, and very little secretion was expelled from his lungs, in which was

lodged a small quantity of viscid exudation. With the aid of suitable internal remedies he gained ground very slowly. A liniment of camphor and ammonia was prescribed, but it did not help him very much. Goose grease was added, and at once its effect became apparent. In a day or two, feeling much better, he omitted the use of the oil, and he became worse; but after repeated applications great benefit followed. A second and third time he omitted to use the goose grease and the cough and the distress returned, but they were rapidly removed after another application of the oil.

Of its penetrating qualities, says Mr. Symes, there is no doubt. He has seen it remove *muscular rheumatism* in a marked way when rubbed in. Thickening near the joints after sprains or *subacute rheumatic inflammation* will be greatly benefited by its use. Another affection in which the author has seen marked benefit result from its employment is wasting *marasmus*. When rubbed into the abdomen and groins of young children it is a decided nutrient, and experience has convinced him of its efficacy when employed in this way. It can be eaten on bread with salt, and, if freshly prepared, is very palatable and nutritious.

As a basis for liniments, or the softer kinds of ointment, when the effect is desired upon the underlying tissues, the author thinks that there is no better substance to "carry in" a drug to the deeper parts. It much exceeds lard in efficacy and it possesses far greater permeating qualities than vegetable oils. It is liable, however, to beeome rancid, but the author has kept it for many weeks by the addition of some boric acid. Active drugs when incorporated with it and applied externally will, says Mr. Symes, be under the best conditions for permeation, and it will not lie on the surface unabsorbed as much as other oils do.

GOSSYPIUM.—See Cotton.

GRANATUM.—See under Pelletierine.

GRAPE CURE.—In this form of treatment, practised almost exclusively in France and Germany, two methods are followed. In the one the diet is restricted to ripe grapes, and in the other moderate amounts of food containing but little starchy or fatty bodies are allowed. In the first method grapes are eaten at intervals of three or four hours from the time of rising to bedtime. The amount allowed at first is from one to two pounds daily, and this is increased gradually until seven or eight pounds are reached. In the other method nearly the same plan is followed, except that three light meals are permitted. Whichever plan is adopted, it is insisted upon as being of great importance that whenever the condition of the patient admits of it, the first grapes shall be eaten in the vineyard before the moisture which collects upon their surfaces during the night has been dissipated. The other meals need not be taken in the vineyard, and indeed some allege equally good results when a grape diet is followed out in places remote from the points where they are grown, provided they are thoroughly ripe and free from decay. Simultaneously with the use of the grapes the ordinary hygienic rules laid down in all sanitaria, such as regular hours, abundant exercise in the open air, etc., must be lived up to. These undoubtedly aid in the benefit derived from the grape cure, but there is in addition sufficient evidence that abstinence from ordinary articles of food and the substitution of large quantities of fresh fruit are of decided advantage. The white grapes of the varieties commonly found in hot houses in this country are the ones generally used. The skins and seeds are rejected in all cases except those in which a laxative or diuretic effect is sought for. The freshly expressed juice is advised by some as an adjunct, and bathing in the fermenting must by others. The composition of grape-juice closely resembles that of human milk, but it contains somewhat larger quantities of iron, phosphates, and vegetable acids, and, with the addition of a moderate amount of fluid and nitrogenous elements, is entirely sufficient to maintain a healthy condition of the organism.

The system seems to be perfectly rational, consisting in the administration of large amounts of easily digested food containing iron and phosphates in a readily absorbable form under very favourable conditions as regards surroundings. The protracted use of large quantities of grapes will sometimes affect the enamel of the teeth, and it is advisable to rinse out the mouth with a weak alkaline solution after eating them. Aphrodisiac effeets have been ascribed to them, but their effect in this direction is extremely feeble, if any. Slightly different effects are experienced according to the nature of the soil in which the grapes are grown, those from a wet, clayey soil being laxative, those from a volcanic or granitic soil being diuretic and stimulant, and those from soils containing iron drawing considerable amounts of that metal from them. Some judgment, therefore, is to be exercised in the choice of the particular variety to be used. The conditions in which the most benefit is to be derived from this form of treatment are *plethora, engorgement of the portal circulation, enlargement of the spleen, functional disorders of the liver, hæmorrhoids, chronic diarrhœa, intestinal catarrh, scrofula, tuberculosis*, and *phthisis*. Unfermented and sterilized grape-juice is largely sold. When it is unsophisticated and free from boric or salicylic acid as a preservative it is a pleasant non-aleoholic beverage, which may be used to advantage in *convalescence* from disease and where a mildly nourishing drink is desirable.

Russell H. Nevins.

GREEN SOAP.—See under Soap.

GRINDELIA (U. S. Ph.) is the leaves and flowering tops of *Grindelia robusta* and *Grindelia squarrosa*, herbaceous perennial plants of the *Compositæ*, indigenous to the Pacific slope of the United States and Mexico, where they are common along the coast and in the mountains. They contain a resin, which is probably the active constituent, a fixed and a volatile oil, also robustic acid and an alkaline principle named *grindeline*. There is but one official

preparation—viz., *extractum grindeliæ fluidum* (U. S. Ph.), fluid extract of grindelia, containing much resin. The dose is from 10 minims to 1 fl. drachm or more, every three or four hours, in sweetened water or milk, the mixture being well stirred to prevent the resin from adhering to the glass.

Grindelia has an acrid, bitter taste, and excites the secretion of saliva when it is chewed. Its principal action is that of an antispasmodic, but it is also a motor depressant, somewhat expectorant, and decidedly diuretic. Given in large doses to small animals, it induces paralysis, beginning in the hind extremities and affecting the sensory nerve-trunks first, then the sensory side of the spinal cord, afterward involving the motor nerve-trunks, and finally the spinal motor tract. It stimulates the cardiac inhibitory apparatus and the vaso-motor centre, slowing the heart and respiration, and raising the blood-pressure. In sufficient quantity it causes dilatation of the pupils, reduced cutaneous sensibility, and sluggish reflexes, even narcotism in small animals. Its elimination occurs by the bronchial mucous membrane and the kidneys, both of which it stimulates. In large doses it has produced renal irritation.

Grindelia is chiefly employed as a palliative in *spasmodic asthma* and the *dyspnœa* accompanying *bronchitis*. In several cases of recurring asthma in elderly persons half a drachm of the fluid extract has afforded almost instantaneous relief, but has not prevented the return of the paroxysms. It is efficient in *chronic bronchitis*, especially that of the aged, also in *whooping-cough* and other *spasmodic coughs*, in *hay-fever*, and in the dyspnœa of various pulmonary and cardiac affections, and in *chronic cystitis* it has been employed with benefit. Locally, it is used with advantage as a lotion for the dressing of *burns* and *blisters*, in *elytritis* and *uterine catarrh*, and to allay the pain of *herpes zoster*. In the proportion of 1 part of the fluid extract to 9 parts of water, as a sedative lotion, it is a very efficient application for the *cutaneous irritation due to poison-oak or ivy*, also in skin diseases attended with *itching* and *burning sensations*.

Samuel O. L. Potter.

GUAIAC, *guaiacum resin*, *guaiaci resina* (U. S. Ph., Br. Ph.), is a resin obtained from the wood of *Guaiacum officinale* and *Guaiacum sanctum*, trees native to the West Indies and the northern portions of South America. The methods of its preparation are several. It may be obtained as a natural exudation, or by incising the trunk of the tree, or by the application of heat to the wood with the result of driving out its juice, or by boiling the finely divided wood in a solution of sodium chloride and skimming off the resin which collects upon the surface. It is imported in irregular masses which contain fragments of wood, sand, and other impurities. Externally they are of an olive colour; internally they are apt to be reddish-brown, but are often mottled and variously coloured. Guaiac is brittle and the freshly broken surface is lustrous and glassy. Its odour is feeble but aromatic and becomes stronger under the influence of heat, while its taste, at first very faint, is afterward acrid and pungent. Its powder is grayish, but assumes a green colour upon exposure to air. It is soluble in alcohol as well as in the test solutions of potassium and sodium hydrate. In water it is but slightly soluble. If tincture of ferric chloride is added to the alcoholic solution of guaiac a blue colour results, and the same colour arises from the combination of guaiac with gluten, mucilage of gum arabic, milk, or freshly cut roots like potato. Blood stains may be recognised by the action of tincture of guaiac upon them in the presence of an ozonized substance like hydrogen peroxide, for under these conditions a blue colour is produced. The composition of guaiac is complex and its constituents include guaiaconic acid, guaiarrhetic acid, guaiacic acid, and guaiac yellow.

Taken by the mouth, guaiac causes a sense of warmth in the stomach and increases to some degree the secretion of the digestive juices. It is supposed to increase circulatory activity as well as diaphoresis somewhat, but these results are not prominent from the use of the drug uncombined. In large doses guaiac is capable of causing a considerable amount of digestive irritation, and the purgation occasioned by it has been thought valuable in *chronic rheumatism*. It has been regarded by some as an emmenagogue, but its chief employment has been as an alterative. In *syphilis* it has long been used, both alone and in combination with other remedies, but modern medicine credits it with little value in this disease and it has now a very limited employment. In *chronic rheumatism* and *gout* and in various forms of *chronic skin disease* it has been praised for its alterative effect, but that it has any direct curative value in these conditions is questionable to say the least. The use of tincture of guaiac in acute *pharyngeal* and *tonsillar inflammations* is more reasonable, for benefit in such cases is not an uncommon result. Guaiac may be given in powder, in pill, or in suspension, but its tinctures are more commonly the forms employed. If given in substance, the dose is from 10 to 30 grains. Tincture of guaiac, *tinctura guaiaci* (U. S. Ph.), contains 20 per cent. of guaiac. The dose is from 1 to 2 fl. drachms, and it may well be administered in milk, for, though the resin is precipitated from all watery solutions, suspension in milk is sufficiently lasting to render the practice desirable. The ammoniated tincture, *tinctura guaiaci ammoniata* (U. S. Ph., Br. Ph.), is a solution of guaiac in aromatic spirit of ammonia. The preparation of the U. S. Ph. contains 2 parts of guaiac and enough aromatic spirit of ammonia to make 10 parts. The dose is from 1 to 2 fl. drachms. The preparation of the Br. Ph. contains 4 ounces of guaiac in powder and enough aromatic spirit of ammonia to make 1 pint (Imp. meas.). The dose is from $\frac{1}{2}$ to 1 fl. drachm. Guaiacum mixture, *mistura guaiaci* (Br. Ph.), contains 1 part each of guaiacum resin and refined sugar, $\frac{1}{2}$ part of powdered gum acacia, and 40 fl. parts of cinnamon water. The dose is from $\frac{1}{2}$ to 2 fl. oz.

Henry A. Griffin.

GUAIAC WOOD, *guaiacum wood, lignum vitæ, guaiaci lignum* (U. S. Ph., Br. Ph.), *lignum guajaci* (Ger. Ph.), is the heart wood of *Guaiacum officinale* and of *Guaiacum sanctum.* The latter source, however, is not recognised by the Ger. Ph. As obtained for use in pharmacy, the wood is in the form of chips or raspings, which are olive, brown, and yellow in colour, intensely hard, and possessed of a faint aromatic odour, especially noticeable when the wood is heated, and of an acrid taste which is developed by chewing. To a slight degree it imparts its virtues to water. The medicinal properties of guaiac wood are the same as those of resin of guaiac, and its use in decoction, especially when combined with other remedies, at one time enjoyed great repute in the treatment of *syphilis, scrofula, chronic skin diseases, chronic rheumatism,* and *chronic gout.* It is little employed at the present time.

HENRY A. GRIFFIN.

GUAIACOL, *methylpyrocatechin*, is a highly refractive, colourless liquid of aromatic, agreeable odour. Its graphic formula is $C_7H_8O_2 = C_6H_4\left\{\begin{matrix}OCH_3\\OH\end{matrix}\right.$. It has a specific gravity of 1·33 at 59° F., and boils at 200° F. It is produced by the fractional distillation of beech-wood creosote, of which it constitutes from 60 to 90 per cent. It is also obtained by the dry distillation of guaiac resin and is produced synthetically from pyrocatechin acted upon by methyl sulphuric acid. The purest form of guaiacol is that made synthetically. Guaiacol is slightly soluble in water, in the proportion of 1 to 1,000, and very easily soluble in alcohol and in ether. With an aqueous solution of ferric chloride it gives first a yellowish then a pure brown colour. A further chemical test is that of dissolving 3 grammes of guaiacol in 5 c. c. of absolute alcohol and adding very dilute ferric chloride, upon which a blue colour is struck, changing at once to green.

The derivatives of guaiacol are *benzosol, guaiacol salol* (salicyl-guaiacol), *styracol* (cinnamyl-guaiacol), *guaiacol carbonate,* and *guaiacol biniodide.* Of these, benzosol, guaiacol biniodide, and styracol are least used therapeutically. *Guaiacol biniodide* is a reddish-brown powder, with an odour like that of iodine, and soluble in alcohol and in the fatty oils. It has been recommended and used as an external application in *pulmonary* and *arthritic tuberculosis;* but it is inferior in this respect to guaiacol pure or in combination. *Styracol* is broken up in the intestines into cinnamic acid and guaiacol, and each is supposed then to exert a favourable influence on *pulmonary tuberculosis* and on *chronic catarrh of the gastro-intestinal* and *genito-urinary tracts.* Clinical evidence is very meagre on these points, however. *Guaiacol carbonate* is prepared by decomposing guaiacol in a solution of soda with carbonyl chloride. Its formula is $CO(OC_6H_4OCH_3)_2$. It is a neutral, white, crystalline powder containing 91 per cent. of chemically pure guaiacol in combination with 9 per cent. of carbonic acid. It is insoluble in water and in cold alcohol. It dissolves in ether, in chloroform, in benzene, and in boiling alcohol, and is slightly soluble in the fixed oils and in glycerin. It is practically tasteless and has no odour. For the therapeutic uses of guaiacol carbonate, see under that subheading.

Guaiacol has gained in recent years a therapeutic hold as a substitute for its congener, creosote. It can be given in larger doses, is less irritating, and has more pronounced effects than creosote. Clinical experience seems to justify its use, though, like most of the newer remedies, it has been abused. Professor Max Schüller, of Berlin, was the first to use guaiacol in *tubercular diseases,* and since his first publication it has been introduced into general private and hospital practice. The disappearance of active symptoms, such as night sweats and loss of flesh and strength, and the general well-being of the patient produced by it, make it a desirable adjuvant in the treatment of pulmonary tuberculosis, though it must not be regarded as a specific for the disease or for any form of it.

Guaiacol can be administered by the mouth, by the rectum, by hypodermic injection, by inhalation, and by rubbing into the skin. These methods will be considered *seriatim.* Given *internally,* in doses of from 1 to 8 grains, it is well borne by the stomach as a rule, though not all patients can stand pure guaiacol. If it is desired to use guaiacol which is sure to be pure, the synthetical preparation should be used, for that has recently been shown to be the most reliable form of the medicament on the market. Within eight hours it can be found in the urine, and its odour is noted in the breath within five hours after its administration. Its first action in *fever* is as an antithermic. The temperature will fall rather slowly in from two to four hours. Immediately upon reaching the lowest limit, it will rise again to its original figure very rapidly, sometimes even reaching a higher point. The rise occupies half the time of the fall. During the time of the fall of the temperature patients frequently complain of the depressive action of the drug. The effect upon the respiration and pulse from an ordinary dose is only transitory and superficial. The blood-pressure is slightly increased and there is a little constriction of the arterioles. Respiration is not effected, though one observer maintains that inspiration is deepened two hours after the internal administration of the drug. There is but one case of poisoning by guaiacol on record. In this case, that of a nine-year-old girl, 1¼ drachm was taken by mistake. The face became cyanotic and the corneal reflex was almost completely abolished. The pupils were in mid-dilatation and but slightly responsive. There were severe vomiting movements and a flow of saliva from the mouth. The pulse was regular, weak, 134; cutaneous sensibility was diminished; and there was pronounced apathy. Later, blood and bile-coloured mucus were vomited. The urine was dark-coloured and gave an aromatic odour; biliary colouring matter was present. There was a marked increase of sulphates, phosphates, and uric acid, with 2 per cent. of albumin. The autopsy dis-

closed a glossitis, superficial pharyngitis, acute follicular gastritis, with small excoriations, enteritis, a very large spleen, incipient parenchymatous degeneration of the liver with icterus, acute hæmorrhagic nephritis with hæmaturia and hæmoglobinuria, cardiac dilatation with parenchymatous degeneration of the muscle, ecchymoses in the pleura, pericardium, endocardium, and peritonæum. (Wyss, *Deutsche med. Wochenschrift*, 1894, No. 13.)

Patients taking guaiacol because of *pulmonary tuberculosis* are obliged to continue its use for many months, and, since its action is slightly cumulative, it is well to begin with moderate doses. The dose at the beginning for children should be from 1 to 3 drops of guaiacol in twenty-four hours. For adults the dose to begin with may be from 3 to 5 drops four times a day. This may be increased gradually to 5 drops three or four times a day—only, however, if the patient can stand taking the pure drug into his stomach. In pill form the dose for adults is from 1·6 grain to 8 grains in twenty-four hours, in doses of from 0·8 to 1·6 grain. It may be given in capsules or in an oily or alcoholic solution. A very good formula is:

℞ Guaiacol.............	150 grains;
Rum................	450 "
Distilled water.......	6½ fl. oz.

Of this solution from 8 to 10 drachms may be taken daily, in milk or water. The guaiacol may be given in wine or milk and is not distasteful to some patients when so administered.

The drug has been recommended as having a distinct effect on the elimination of sugar and on the flow of urine in *diabetes mellitus*, in doses of from 3 to 5 minims. It is alleged for it that the general condition of the patient is improved by its use. It may be rubbed in for the same purpose by the method hereinafter described. The dose would be half a drachm. Owing to its strong eliminative powers, it has been used—meagrely, however—in *acute* and *chronic* forms of *nephritis*.

Whether administered internally or in any other way, guaiacol is excreted by the kidneys as guaiaco-sulphuric ether. It is partly thrown off by the lungs. It is always found in the urine, and when too large doses have been given it colours the renal excretion dark as carbolic acid does. So far as is known, proper doses have never caused kidney trouble.

It is difficult to formulate a statement as to the manner in which guaiacol acts beneficially in pulmonary tuberculosis, since its precise mode of action is not understood. It is believed that it forms compounds in the blood with the toxines produced by the presence of the tubercle bacillus in the organism, and that it aids in eliminating them from the system. Klemperer, of Berlin, in his published and private writings, believes that its benefits are due to its action as a bitter tonic on the stomach, increasing the amount of the digestive fluids and thus producing good assimilation. The entire phenol group has this action on the mucous membrane of the gastro-intestinal tract, so Klemperer's views are probably correct, if only in part. There can be no doubt, however, that guaiacol does influence the course of pulmonary tuberculosis. There is an increase of appetite, with improvement in the digestion, which leads gradually to restoration of flesh and strength. Consequent upon the general improvement, sleep is rendered easier and more restful, and night sweats, if not diminished or checked altogether, are less enervating than before the use of the drug. With the bettering of the patient's general condition the coughing becomes easier—particularly if other proper remedies are in use—and the attacks grow less frequent. We must rest on clinical authority for the statements that the physical signs become diminished and that the number of bacilli is decreased. Guaiacol is *not* a specific for phthisis; it acts as a tonic and as an antipyretic and antiseptic agent. The writer believes that specific agents for the cure of the infectious diseases must be derived from some combination or modification of the toxines developed and acting in each specific disease; and that these agents will act through the blood. Until these curative products are at our command, however, we have, in tuberculosis at least, an aid of considerable value in guaiacol. If cases of phthisis are reported cured through its agency, it is because they have been subjected at the same time to proper hygienic conditions and surroundings and have received such other treatment as enabled the guaiacol to be of assistance to the organism.

Ketchart has established the principle that the rectum will assimilate as much and as quickly as the stomach, and, though this dictum may well be doubted in the case of semiliquid articles, it appears to hold true in the case of vaporous fluids. Girtnert, acting in this belief, used guaiacol in *enemata* and professed to have obtained the full effects of the drug—antipyretic and depressive—in a few hours. Dr. William H. Gregg, of New York, has used the drug in the same way, employing a mixture of tincture of iodine, guaiacol, and olive oil in the proportions of 4, 32, and 1,500. He injects a fluid ounce of this mixture at the beginning of the treatment, and increases the dose gradually until the patient perceives the taste of guaiacol and the drug appears in the urine. Though there seems to be no reason to doubt the efficacy of this use of guaiacol, the dose can be more satisfactorily gauged by other means at our disposal and with less annoyance to the patient.

When guaiacol is administered *hypodermically* it must be dissolved in sterilized neutral olive oil, and is usually given in a solution having the proportions of 1 to 5. The subcutaneous dose is from 1½ to 4 grains, but the treatment must be begun with the smaller and gradually increased. Lannois, who has had a large experience, has found bullæ and even small areas of sphacelus in the skin after the subcutaneous injection of the drug, and does not, therefore, recommend its administration in this way. Lannois and Linossier (*Union méd.*, April 1, 1894) have shown that hypodermic injections of equal parts of guaiacol

and oil of sweet almonds produce a lowering of temperature equal to that brought about by painting guaiacol on the skin. They report one case in which the temperature fell from 102° to 95·5° F., with chills and collapse. At the same time, the urine contains traces of the drug after its subcutaneous injection, so there can be no doubt that it is absorbed.

In *pulmonary tuberculosis*, where the symptoms are sluggish, in the period where expectoration is abundant after cheesy degeneration, Weill uses guaiacol, in doses of from 8 to 12 grains, hypodermically, combining the drug with sterilized oil. He advises prudence in erethetic cases because of possible congestion and hæmoptysis. In *chronic bronchitis*, *fœtid bronchitis*, and *pulmonary gangrene* Grainger Stewart advises the hypodermic use of guaiacol. In chronic bronchitis he advises, in addition to the subcutaneous use of the drug, intralaryngeal injections of a mixture of 2 parts of crystallized guaiacol, 10 of menthol, and 88 of sterilized olive oil. It is alleged that after a resection of a rib for *empyema* the purulent secretion rapidly diminishes under the subcutaneous use of guaiacol (*Brit. Med. Jour.*, May 24, 1893). The objections to its employment subcutaneously, as well as the increased danger and disagreeable sequelæ, lead one to prefer other methods of administration.

The volatility of guaiacol makes it especially adaptable for *inhalation*. When Schüller first began to employ the drug in pulmonary tuberculosis he gave it to his patients by inhalation, presenting it in a 1-to-600 aqueous solution. He has recently concluded, however, to use it in this manner only when there is a tubercular catarrh of the respiratory mucous membrane. Lannois and Linossier (*loc. cit.*) have shown, in a patient suffering from typhoid fever, that guaiacol is absorbed when inhaled, as it appeared in the urine at the end of six hours. A new use for the drug by inhalation has been lately advocated by Richardière (*Union méd.*, Aug. 10, 1895), who proposes that it shall be given to patients with *fœtid bronchitis* and *gangrene of the lungs*. In the latter disease the terrible odour is as harmful to the patient as it is disagreeable to the attendants. It is apt to cause a distaste for food, with consequent malnutrition. To mask the smell and at the same time act beneficially on the local process, it is necessary to use an antiseptic vapour that will reach the bronchial tubes without doing injury to their mucous membranes. This purpose is fulfilled by guaiacol. The author recommends its use with a common oxygen inhaler every ten minutes, the vapour to be left in contact with the air-passages as long as possible and to be slowly expired. Atmospheric air may be used, but the oxygen is useful as an adjuvant. In *fœtid bronchorrhœa* and in *chronic bronchitis* the guaiacol may also be used by inhalation with good result.

As a *topical application* for *antithermic* and *analgetic* effects guaiacol has been warmly recommended in a variety of combinations. Its antipyretic power can not be questioned in view of the mass of clinical evidence by competent observers. Da Costa (*Med. News*, Feb. 2, 1884) has found it of value in reducing temperature in *typhoid fever* and *tuberculosis of the lungs* where the drug has been painted on the surface. Not more than 30 minims of guaiacol must be used at a time, says this writer, although Bard, Lannois, and Guinard use 45 minims and J. Solis-Cohen, of Philadelphia, uses 35 minims in the majority of his cases. After painting the drug on the surface selected there is a rapid fall of temperature with a subsequent rise, accompanied by profuse sweating and feeble action of the heart approaching syncope. The rise, as after the internal administration of the drug, is more rapid than the fall of temperature, and patients complain of the depressing action on the heart. Carter has made a study of the effect of guaiacol on the temperature (*Brit. Med. Jour.*, July 7, 1894). He agrees with Guinard that the fall of heat is not due to absorption, but that guaiacol acts on the thermogenetic centres by exciting the peripheral nerve terminations and acting in a reflex way on the functions of the centres. The presence of the medicament in the urine shows that it has entered the system directly or indirectly through the respiratory passages; if it is excluded from the pulmonary circulation, it is not found in the renal excretion. The quantity of vapour absorbed by the lungs during the process of painting and rubbing in the drug is not sufficient to account for the great fall of temperature, amounting sometimes to 6° F.; it must therefore be due largely to central action.

This method of employing guaiacol is best accomplished by washing the skin over the area to be rubbed with soap and warm water and thoroughly drying it. It is best, when feasible, to choose the skin over the site of the lesion in tuberculosis. The guaiacol is poured into a dish, taken up with a camel's-hair brush or absorbent cotton, and painted on the skin until it is absorbed. This should take from ten to fifteen minutes. The skin is then rubbed dry with the hand and the area is covered with some impermeable substance—cotton, oiled silk, or rubber tissue. A bandage may be placed over this. There are often smarting and burning for the greater part of an hour; and the manœuvre is sometimes followed by a mild superficial dermatitis with slight subsequent desquamation.

The immediate effect of the painting and rubbing is a fall in the temperature of two or three degrees. It may even go below normal, but will return to normal and remain there in tubercular subjects. Solis-Cohen observed one patient in whom the temperatnre remained normal for six weeks after one application of 35 minims (*Med. News*, vol. lxv, No. 21). There is always a marked general sweating, usually proportionate to the fall of temperature. The pulse and respiration become less frequent as the body heat becomes less. Besides its antipyretic effect, guaiacol exerts a diaphoretic action which can well be taken advantage of in some conditions, and has the influence of an internal antiseptic as well. Its action on the

skin is not so caustic as that of creosote, which has produced sphacelus of the superficial layers. The topical action of the drug is enhanced when the rubbed and painted area is covered with some impermeable dressing. It gains its influence by being absorbed through the skin in vaporous form. It must always be used pure or in some vehicle in which it can be absorbed to produce its antithermic effect. Its absorption is very rapid. In fifteen minutes after painting it on the skin, guaiacol is found in the urine. It reaches its maximum in the urine in from one and a half to four hours, and elimination is complete in twenty-four hours. As a rule, over 50 per cent. of the guaiacol used can be found in the urinary excretion.

In estimating the value and effect of the topical use of guaiacol, three factors must be taken into consideration: 1. The quality of the drug, which must be pure. 2. The personal idiosyncrasy of the patient, who may not be able to stand a large, or even a usual, dose of the drug. 3. The condition of the patient's health. In a healthy man there will be no fall of temperature, and, except for its somewhat depressing and diaphoretic influences, its action will be *nil*. The effect on a man with abnormal temperature, however, will combine antipyresis, diaphoresis, and depression. On a patient dying with a high temperature, no antithermic influence will be exerted by guaiacol. Further, it has been shown by Da Costa that a dose rubbed in on the thigh might prove dangerous if applied to the abdomen. The relative absorptive powers vary in the thigh, the chest, and the abdomen, the first absorbing the least, the last the greatest amount.

The therapeutic uses of guaiacol topically are manifold. Foremost is its employment in *pulmonary tuberculosis, acute*, and *chronic*. As is insisted upon throughout this article, its action in this disease depends upon its antipyretic powers, its restoration of the gastric and intestinal functions, the general systemic improvement that follows its use, and the consequent cessation or mitigation of cardinal symptoms. In selected cases of *acute miliary tuberculosis* its antithermic influence is of greater and more lasting value than in cases of chronic tuberculosis in which large cavities exist. Its antipyretic effect in these cases is rapid and lasting, as a rule. The amelioration of the general condition shows itself in the improved nutrition and local signs and symptoms. After its use there are sometimes erythema, hypothermia, and a tendency to collapse. If severe, the last-mentioned symptom must be promptly met. It is said that the collapse is not due to the drug, but to impurities existing in it. The daily amount to be used in acute miliary tuberculosis varies from 8 to 30 grains, given in divided doses. A good mixture for use in rubbing in these cases consists of equal parts of guaiacol and sweet-almond oil. Bartoszewicz uses compresses of guaiacol, containing 25 to 30 drops of the pure drug, applied next to the skin, covered with waxed paper and a bandage. It is to be doubted if as good results can be obtained as from rubbing; certainly the effect can not be so rapid. Finally, guaiacol exerts no beneficial action on the "hectic fever" of the last stage of tuberculosis.

In *typhoid fever*, where the cold bath is contra-indicated or impossible, guaiacol offers an excellent substitute as an antipyretic. There is this difference, however, that the drug is depressing, while the bath is stimulating. A normal temperature can be maintained by rubbing the drug into the skin in doses of not more than 8 drops at a time, or 30 in a day. Dr. James S. Carpenter (*Therap. Gazette*, 1895, No. 6) has recently reported a series of forty cases in which the drug was used epidermically in doses of from 15 to 35 drops. He chose the epigastrium as the site for the application. The rubbing-in was followed in the course of half an hour by a fall of temperature accompanied by more or less profuse perspiration and followed in varying periods of time by a rise. He regards urgency of symptoms as the guide to the frequency of the application. Guaiacol can not be regarded as a specific in typhoid fever, and probably it will not furnish results to equal those of the Brandt treatment; but where this can not for any reason be carried out, guaiacol, by reason of its antipyretic and diaphoretic action, is a clearly indicated medicament.

In *pleurisy with effusion* guaiacol has some reputation. It is rubbed in in combination with tincture of iodine (1 to 5). It has its usual effect of causing a fall in the temperature with diaphoresis and diuresis, increasing the flow of urine and bringing about resorption of the effusion. Observations of its use in this disease are still limited, but it is probably of considerable value.

In *infectious diseases* with high temperatures, when other antipyretic measures are not indicated or would be injurious, guaiacol may sometimes be used with advantage. Success has been reported with it in *pneumonia*, in *pyæmia*, and in *influenza*. After all, guaiacol is still too new a member of our armamentarium for its full virtues and influences to be known. We are still in the experimental stage and the drug requires further study as to its modes of action.

In *erysipelas*, particularly of the facial type, guaiacol has many advocates as an external application. It may be diluted for this employment with alcohol or the fixed oils. It is painless except in cases where there exists extreme irritability of the skin. From 20 to 30 minims may be painted over and beyond the infected area. It will not always check the course of the disease at once, but it will reduce the temperature and relieve the pain. After its use there is sometimes felt an exaggerated sensation of heat in the extremities and hands, which is supposed to be caused by the covering of the painted area.

In *acute amygdalitis* of the lacunar or follicular variety guaiacol, locally applied on a cotton swab, brings relief of pain and a slight decrease of temperature, though it does not seem to hasten convalescence. At first the application is unpleasant and causes some irri-

tation, which is intensified by the preliminary use of cocaine. This is very brief, however, and the patient can swallow more easily after the application. In phlegmonous amygdalitis there is no evidence that it has any action of a beneficial kind.

The analgetic influence of guaiacol has caused its local use in *arthritis deformans* and *rheumatic joints*. In these conditions equal parts of guaiacol and glycerin, painted over the painful areas and covered with a dry, impermeable dressing, will sometimes bring relief. In *sciatica*, in *coxalgia*, and in *neuralgia* in the shoulders or elbows, painting the affected sites with guaiacol, pure or in combination, will ameliorate the pain.

It is said that in the *dermatitis* which sometimes follows vaccination the epidermic use of guaiacol relieves the pain and hastens convalescence. But here, as in other ailments and diseases, observation is too limited to make any positive statement.

In the form of an ointment, 2 or 3 parts of guaiacol to 30 of vaseline or lanolin, good results have been obtained in *blennorrhagic epididymitis*. Pure guaiacol or the ointment can be rubbed on the scrotum or thigh with quick relief of the pain. Two or three applications are made on the first day, and by the third day of the disease the pain disappears (*Union méd.*, April 10, 1894).

As a *local anæsthetic*, guaiacol has been brought forward by Championnière (*Mercredi méd.*, July 31, 1895). He cited the case of a druggist who had burned his hand and had received instant relief by pouring guaiacol over the burned member. In solutions of 1 to 10 or 1 to 20 it may be used in *dental surgery* and in *minor surgical procedures*. This writer says it is slow to produce anæsthesia, but that its action is more enduring than that of cocaine. Fifteen minims may be injected subcutaneously, and when mixed with equal parts of glycerin it does not irritate the skin. There is occasionally syncope with hypothermia, and there is danger in using the drug in this manner, because of its vaso-constrictor effect and its very rapid absorption.

Guaiacol carbonate has stated for it ease of administration, its lack of taste and odour, and the fact that it does not irritate the digestive tract. Its therapeutic indications are as an internal substitute for pure guaiacol in *pulmonary tuberculosis* and *typhoid fever*. The statement is made for it that it cuts short the usual long course of typhoid fever and diminishes the frequency and severity of secondary symptoms. The intestines are acted upon locally, guaiacol taking the rôle of an antiseptic, the compound being broken up in the small intestine into pure guaiacol and carbonic acid. Nervous symptoms are diminished and convalescence is hastened. In tuberculosis the compound accomplishes no more than pure guaiacol. The dose of the carbonate is from 7 grains thrice daily to 45 grains in divided doses, increasing the dose every third or fourth day. The drug is well borne by the stomach and has the advantage of being tasteless.—Samuel M. Brickner.

GUAIACUM.—See Guaiac and Guaiac Wood.

GUARANA (U. S. Ph.) is a dried paste composed chiefly of the crushed seeds of *Paullinia cupana* (*Paullinia sorbilis*), a climbing plant growing in the eastern parts of South America and especially in Brazil. The paste is prepared by the Guaranis, a tribe of Indians. Though variations doubtless occur, the usual method of preparation is as follows: The seeds, which resemble the horse-chestnut, though smaller in size, are shelled, washed, and roasted for several hours. They are then pounded in a mortar and the powder which results is mixed with water so that a paste is produced which is fashioned into masses of various shapes. These masses are then dried, either in the sun or by the action of artificial heat. As they occur in pharmacy the guarana cakes are hard, globular or cylindrical in shape, of a reddish-brown colour, of a slight odour which is similar to that of chocolate, and of a bitter and astringent taste. The drug is slightly soluble in water as well as in alcohol. Guarana contains gum, starch, tannin, fixed oil, volatile oils, and caffeine tannate. Formerly it was supposed that the crystallizable principle obtainable from guarana was an alkaloid peculiar to this substance, but further investigation demonstrated that the so-called guaranine was simply caffeine.

Although guarana contains an amount of tannin sufficient to cause slight astringent action, and therefore its employment for intestinal disorders, as practised by the South American Indians, is reasonable, yet it is seldom employed for this purpose elsewhere, and its action and therapeutics are practically no other than those of its active principle caffeine. (See Caffeine.) Guarana has been recommended as a tonic and reconstructive for use in *convalescence*, *debility*, and all states where nerve action is impaired and where economy of tissue is important. Its most frequent application, however, is for the relief of *sick headache* or *migraine*. Given in this condition, its action is often strikingly beneficial. Guarana may be given in powder in doses of from 1 to 2 drachms, but the more usual form of administration is that of the fluid extract, *extractum guaranæ fluidum* (U. S. Ph.), of which the dose is from 1 to 2 fl. drachms.

Henry A. Griffin.

GUM ARABIC.—See Acacia.

GUN-COTTON.—See Pyroxylin.

GURJUN BALSAM, or, as it is sometimes called, *wood oil*, is obtained from several species of *Dipterocarpus*, mostly from *D. turbinatus*, Gaertner (*D. lævis*, Hamilton), lofty trees growing in eastern India from Bengal to Tenasserim, and also in the East Indian and the Philippine Islands. A hole is cut in the tree about three feet from the ground and about four to five inches deep, the hole being hollowed so as to retain the oil. The whole interior of the cavity is then charred by fire, without which the oil does not exude. In this manner the oil may be taken from the same tree year after year, and two or three holes may be made

in the same tree. After the oil is removed from the hollow in which it collects it is allowed to settle, when the clear part separates from a thick portion called the *quad*. One tree will yield from 3 to 5 maunds (250 to 400 pounds) yearly. The oil or balsam is a somewhat viscid liquid, resembling in many of its properties copaiba, but it has not so strong an odour, while its taste is more bitter and aromatic and is less acrid. Its colour varies from greenish gray to brown. It is transparent and, viewed by transmitted light, appears of a dark-brownish or reddish tint. It is soluble in chloroform, partly so in alcohol, in ether, and in petroleum benzine. With water, in the porportion of 1 to 5, it forms a perfect emulsion. It is an oleo-resin, yielding on distillation a volatile oil which, after escaping, leaves behind a resin (about 37 per cent.). A crystallizable acid is contained in the resin in small proportion, which is termed gurjunic acid, $C_{22}H_{34}O_4$.

Gurjun balsam has been employed as a succedaneum for copaiba, and also (on account of its greater cheapness) has sometimes been used to adulterate the latter. It has been said to possess advantages over copaiba, aside from being less expensive, in that it very rarely causes any erythema of the skin, produces no unpleasant odour of the breath or urine, and, furthermore, sometimes succeeds where the copaiba has failed.

For *gonorrhœa* it has been used with considerable success. It may be given in emulsion in limewater, equal parts, in tablespoonful doses. Vidal recommends the following:

℞ Wood oil, Syrup, each...... 1 fl. drachm;
Infusion of aniseed.... 10 fl. drachms.
M.

The mixture is administered twice a day at the beginning of meals. The only effect on the intestinal tract observed is the occasional occurrence of one or two loose movements within two hours after taking the medicine. It is said that a quarter of a glass of wine after the dose makes it better tolerated. For *vaginal blennorrhagia* the following treatment is recommended: The vagina having been washed out with warm water, a plug of cotton wool that has been soaked in an emulsion of equal parts of the balsam and limewater is introduced and is retained in place by another plug of dry cotton. This dressing is renewed daily. For the first three days there is slight smarting, which afterward disappears.

As an *expectorant* gurjun balsam has been used in the same cases for which copaiba has been advised. One or two drachms in an ounce of extract of malt may be given three times a day.

In India this drug has been much used in the treatment of *leprosy*. Dougall, Milroy, Peters, Hillis, and others have reported very favourable results. Elsewhere the reports have been less favourable. It is employed both locally and internally. An emulsion of 3 parts of limewater to 1 of the oil is thoroughly rubbed into the affected parts for two hours twice a day, being applied as a dressing also to the leprous sores. Internally it is given in capsules, in emulsion with limewater or with gum arabic and infusion of aniseed. The dose of the oil is from 6 to 60 drops. It is believed to have a specific effect on the sweat glands of the anæsthetic areas, producing perspiration in these parts and at the same time causing a return of sensibility. On the other hand, certain writers (Beavan Rake, Vandyke Carter) regard it as a remedy of doubtful or only temporary value in this disease.

Edward B. Bronson.

GUTTA PERCHA.—This is the concrete juice of *Dichopsis gutta* and of a number of other sapotaceous trees of the East. It is of a whitish colour, sometimes with reddish-brown streaks through it, and at ordinary temperatures is hard, tenacious, and flexible. When raised to a temperature greater than 120° F. it becomes plastic, and is readily adapted to irregular surfaces. Upon cooling, it returns to its former condition, and thus constitutes a very desirable material for splints and for retaining parts in position. It is, however, not so good for these purposes as plaster of Paris, etc., when it is intended to be used for any protracted period, as it is apt to crumble at the edges, and straps or cords can not be attached to it with any degree of success. Consequently its uses are somewhat limited, and it should hardly be employed except when a splint or the like can be held in position by bandages. It also has the disadvantage of being non-porous, and, by retaining the perspiration beneath it, causes more or less discomfort, and may set up considerable irritation of the skin. Its great plasticity, however, rather more than counterbalances its disadvantages when it is necessary to adjust a splint to extremely tender or very irregularly shaped parts.

For surgical purposes it usually comes in sheets of about the thickness of sole-leather. In applying it, a piece of the proper size is immersed in water about as hot as can be comfortably borne by the hands, and after becoming soft it is quickly moulded to the part, previously moistened with water, and removed as soon as it has become hard enough to allow of its being handled without losing its shape. It is then placed in cold water, where it quickly returns to its normal consistence. Care must be observed that the water is not too hot, lest the gutta percha become soft enough to wrinkle and lose its shape.

Between it and the skin it is wise to apply a layer of lint to absorb perspiration and prevent discomfort or irritation. Combined with zinc oxide, silica, etc., to add to its wearing properties, it is very largely used for plugging teeth when more permanent materials are contra-indicated. Pieces of any desired shape or size are sometimes very useful to retain loosened teeth in *fractures of* or *injuries to the jaws.* Melted with equal parts of caustic potash or zinc chloride, it forms a very serviceable caustic, as it may be moulded into any desired shape. These mixtures are rather slow in their effects,

and their action may be very accurately limited. The *liquor gutta percha* of the Br. Ph. contains 1 part of gutta percha in 8 parts of chloroform, and is a very useful preparation as a protective. It dries rapidly, leaving a thin, transparent, and elastic layer of gutta percha which is entirely without irritating effects and is not easily removed with water. It may be applied with a brush, with a rod, or with the finger-tip over all forms of *abrasions, excoriations, shallow wounds*, etc., and on parts liable to become chafed by clothing, etc. *Lepra, psoriasis*, and *eczema marginatum* are often benefited by its employment, and the *pitting in small-pox* may be prevented by covering the vesicles with it. It is ordered by the Br. Ph. in the preparation of mustard paper. Gutta percha should not be confounded with India rubber, which, however, it resembles chemically and in its susceptibility of being vulcanized.

[Gutta-percha tissue, which is simply gutta percha in the form of very thin sheets, may be used as an impermeable layer in surgical dressings.]—RUSSELL H. NEVINS.

GUTTI.—See GAMBOGE.

GYMNASTICS.—See under EXERCISE.

GYNOCARDIA, GYNOCARDIC ACID.—See under CHAULMOOGRA OIL.

GYPSUM.—See PLASTER OF PARIS.

HÆMALBUMIN.—Dr. Max Dahmen, of Crefeld (*Dtsch. med. Woch.*, Apr. 5, 1894), has given the German name *Hämalbumin* to a preparation said to contain all the salts and albuminoids of blood, to be readily soluble in warm water and in alcoholic liquids, and to be susceptible of absorption by a stomach utterly incapable of secreting any digestive principle. He thinks, therefore, that it is absolutely sure to cure *chlorosis*. It has been used successfully by various observers in that disease, in *anæmia*, in *scrofula*, in *ulcer of the stomach*, and in *rickets*. The dose is 15 grains, from three to five times a day. Occasionally it gives rise to troublesome constipation. Cf. HÆMATIN-ALBUMIN.

HÆMATICS are remedies that act through or (especially) upon the blood.

HÆMATIN - ALBUMIN.—Dr. Finsen (*Ugeskr. f. Læger*, No. 51, 1894; *Brit. Med. Jour.*, Feb. 2, 1895, *Epitome*) has succeeded in preparing a durable preparation from blood, consisting principally of dried albumins and containing a large amount of iron. It is a dark-brown powder, odourless, and almost tasteless. It is prepared from the blood of the ox or pig. The albumins are separated from the extractives and salts by means of Panum's method, somewhat simplified, and after many washings the uncoagulated albumins are centrifugalized and then evaporated at a low temperature (*in vacuo*). In the preparation measures are taken to destroy any micro-organisms that may be present. About a pound of hæmatin-albumin contains the albumins of about 6 pounds of blood. The remedy has been tried in cases of *anæmia* at several hospitals in Copenhagen with satisfactory results. It is well borne and easily assimilated. It does not cause constipation, but gives a reddish colour to the motions. The dose is from 1 to 2 teaspoonfuls, three times a day, for adults. It may be taken either pure or mixed with cocoa. Cf. HÆMALBUMIN.

HÆMATINICS. — See under HÆMATOPOIETICS.

HÆMATOPOIETICS are measures which relieve disturbances of the blood-forming functions. The blood and lymph constitute a fluid environment for the cells of the body, furnishing all the food material they assimilate, and carrying away their waste. As the cells are self-regulating, and as the blood itself is a cellular tissue, it follows that *tonics* which improve the cells will necessarily improve the quality of the blood. The resulting increase in vital action improves the tone of both body and mind. This tone is further strengthened by helpful social intercourse with humanity, especially in outdoor sports and tasks, or any agreeable form of judicious *exercise*. The direct action of the light and the heat rays of *sunshine* upon the body is a very important element in the maintenance of a complete blood supply, the wholesome effect of outdoor life being due almost as much to the sunlight as to the purer air and invigorating exercise.

If the cells of the tissues are well fed and cleansed, *nutrition* becomes more perfect. The body being better nourished, a richer quality of blood results from improving the food, the feeding, the digestion, and the absorption into the plasma. Both leucocytes and red corpuscles are thereby benefited. One of the most important foods is *oxygen*, which may be secured by better ventilation and breathing and more absorption into the red corpuscles. The latter are thus the most important elements in the pathology of the blood.

In feeding the tissues the blood is continuously and urgently depleted of large quantities of oxygen. The *hæmoglobin*, which temporarily fixes the oxygen in the blood, may be deficient in each red corpuscle, or the number of these corpuscles may be relatively small, and thus aggregate an insufficient amount. Whether the loss of hæmoglobin is sudden, as in hæmorrhage, or gradual, as in anæmia, the resulting weakness is an indication of the needed *rest*. In some cases *transfusion* of blood may be necessary to prevent death.

In the various forms of *anæmia* the red corpuscles may have been lost by active or passive hæmorrhage. They may have been injured or destroyed by the toxines of the pathogenic microbes, by uræmic poisons, or by the deoxidizing effects of excessive doses of iodine, phosphorus, sulphur, arsenic, turpentine, dilute hydrocyanic acid, the nitrites, the citrates, or the tannates. Closely allied to these are the effects of anæsthetics and of the organic poisons in the exhaled breath which accumulate in ill-ventilated rooms.

Iron, phosphates, and potash are necessary

constituents of the red corpuscles, and form the best *hæmatinics*. *Iron* is a specific for any deficiency of hæmoglobin, multiplying the red corpuscles and enriching them with hæmoglobin both in health and in disease. More oxygen is carried to the tissues to help produce vital energy. The hæmatinic effect of iron can be secured only when the bowels are acting regularly, and, as the astringent action of iron may disorder the digestion, the milder preparation should be tried first, and taken only after meals.

The existence of an iron compound in the chromatin of all cells (A. B. Macallum, *Proc. of the Roy. Soc.*, 1895, p. 261) may further explain the tonic action.

Phosphoric acid, alone or in combination with iron, increases the phosphates in the red corpuscles. *Potash*, combined with iron, increases the red corpuscles and improves their quality. Although a minute quantity of manganese exists in the blood, it is believed to have no hæmatinic action. Alcohol and quinine prevent the oxygen from leaving the hæmoglobin.

A loss of even one third of the volume of the blood may not prove fatal, and the use of subcutaneous or rectal six-tenths-per-cent. *saline injections* will restore the healthful specific gravity of the plasma. *Nourishment*, especially in the form of cod-liver oil, olive oil, cream, or butter, enriches the plasma, the corpuscles, and indirectly restores deficient albumin. *Myrrh* and the *aromatics* produce similar effects, especially increasing the colourless corpuscles. The latter are decreased by quinine and veratrine. Urea is removed by *alkalies*, which render the plasma more alkaline. In *plethora* the patient needs less food, more exercise, and, when rapid relief is imperative, venesection.

HÆMATOXYLON (U.S. Ph.), *hæmatoxyli lignum* (Br. Ph.), logwood, is a mild, unirritating astringent suitable for use in *diarrhœa* due to a relaxed state of the intestinal mucous membrane. The dose of the decoction, *decoctum hæmatoxyli* (Br. Ph.), is from 1 to 2 fl. oz.; that of the extract, *extractum hæmatoxyli* (U. S. Ph., Br. Ph.), is from 10 to 20 grains.

HÆMOGALLOL, or *hæmol*, a product of the oxidation of hæmoglobin, is a ferruginous preparation devoid of taste and harmless to the teeth. Many observers have found it highly beneficial in *anæmia* in doses of 5 grains three times a day.

HÆMOGLOBIN.—The commercial preparation of hæmoglobin, made from bullock's blood, may be either a powder (in which case it is apt to have deteriorated, or to have been sophisticated) or a mixture with syrup or wine, each of which acts as a preservative. It has been used with much success as a remedy in *anæmia*. From 2 to 4 teaspoonfuls of the syrup or 2 wineglassfuls of the wine may be given daily.

HÆMOL.—See Hæmogallol.

HÆMOSTATICS.—The control of hæmorrhage is one of the most important features of surgical practice. Anatomically, hæmorrhage may be considered as *arterial*, *capillary*, and *venous*. Clinically, it may be *primary*, occurring at the time of injury, or *secondary*, occurring after the establishment of inflammation and the commencement of repair, this period beginning in from twenty-four to thirty-six hours after the injury. Secondary hæmorrhage may be due to what is termed *reaction* in the patient's condition, a gradual increase of volume of blood after sudden hæmorrhage due to abstraction of fluids from the tissues and consequent increased force in the action of the heart. It may also occur from separation of sloughs, or from any death of tissue in the part involved.

Natural hæmostasis occurs (1) from the contraction and retraction of a divided vessel; (2) from spontaneous coagulation of blood in presence of the atmosphere. When a vessel is completely severed it contracts longitudinally within its sheath, and at the same time its circular muscular fibres decrease its normal diameter. Contact of the blood with the roughened sheath tends to induce coagulation, and if to this is added atmospheric contact the process is more rapid and increasing, with diminished volume of blood and weakened heart, the result of the extravasation.

Secondary hæmorrhage rarely occurs in wounds that have been made aseptic. However, it may occur in aseptic as well as septic wounds when there is a diseased condition or atheroma of the vessel walls. It is commendable surgery to consider all wounds as possibly subject to hæmorrhage, for the careful attention which this conclusion carries with it may prevent a loss of life in the exceptional cases when hæmorrhage does occur.

In certain conditions, such as inflammatory œdema, and in certain tissues, as in the tongue, in the scalp, and in bone, a sufficient retraction of the divided vessels can not take place, and hæmorrhage is apt to be severe and continuous until arrested by direct compression or by ligature.

In natural hæmostasis, in addition to retraction and contraction of the divided vessel and coagulation, the weakened action of the heart after a certain amount of blood has been lost favours a slowing of the blood current at the point of escape and coagulation within the end of the divided vessel. The finishing process in natural hæmostasis is the permanent closure of the vessel by the exudation of plastic lymph and cicatrization which results from inflammatory cell proliferation.

The surgical means for the arrest of hæmorrhage are:

1. Direct pressure upon the bleeding surfaces, which may be effected by pressing into the wound any substance convenient in the emergency—a clean towel or handkerchief, or any clean cloth; pressure of the finger or closed fist upon the vessel, first above the wound, and, if this does not arrest the hæmorrhage, below it, in order to control both the arterial and the venous flow.

2. Constriction, which is one of the safest ready means for the control of bleeding in any of the extremities. This may be made with a

folded towel, the sleeve of a coat, a belt, or a bridle-rein, but preferably with an elastic tourniquet. If any of the first-mentioned articles are used, it may be necessary to introduce between the member and the constrictor the rung of a chair or a walking-cane with which to twist the tourniquet in order to arrest the hæmorrhage.

When the hæmorrhage is from the trunk, pressure on the wound or upon the vessels going to the wound must be relied upon. Capillary oozing or considerable hæmorrhage from small arterioles and veins may be readily controlled by the application of an ordinary roller bandage over a pad or dressing placed on the bleeding surface; the amount of pressure to be applied will be determined by that necessary for the arrest of hæmorrhage, but it should never be so powerful that the circulation in the limb beyond the compression is materially interfered with; otherwise necrosis from too prolonged anæmia may occur. Equally-adjusted pressure from the tip of the extremity, applied up to and beyond the point of bleeding, will overcome this difficulty. Under such conditions, the toes and fingers should be left exposed, so that the circulation can be closely observed. Esmarch's elastic bandage furnishes the ideal method of temporary control of hæmorrhage during surgical operations. When it is properly applied, hæmostasis is complete and entire, scarcely a drop of blood being lost even in operations upon bone. It should always be employed in operations upon the extremities. In anæmic subjects compression should be applied forcibly from the tip of the extremity up to near the point of disease, but under no condition should the elastic bandage ever be carried over a diseased surface, since the powerful compression it exerts may drive septic matter into the veins or lymphatics and thus produce irreparable damage. When the elastic bandage has been applied, a constrictor should be placed well above the point of operation, and when this is done the Esmarch placed below can be removed.

3. Elevation of a limb at right angles to the body, gravitation returning the bulk of the blood to the centre. The value of posture in the arrest of hæmorrhage can not be overestimated. Even traumatic hæmorrhage that is violent with the body prone upon the ground will often cease spontaneously if the part is elevated as high as possible; and in wounds of the thigh close to the body it has been my habit to place the patient upon a table or bed, and to elevate the feet so that the body reclines at an angle of 45°. After all operations upon the hands, forearms, feet, and legs, the elevated posture should be maintained in order to prevent oozing into the dressing. It may be well to say, however, that in certain cases of amputation, as at the hip joint, it is not always wise to drive all the blood which may be in the sound portions of the diseased limb into the body, especially in plethoric individuals, since the great proportional increase in the blood will throw upon the heart more work than it has been accustomed to perform. In applying constriction to a member of the body, care should be taken to use a wide rubber bandage when such can be obtained, since, if a narrow loop or piece of rubber tubing is used, there is danger of too much pressure being exercised upon a narrow space. In this way nerves have been injured, and I have seen several cases of temporary paralysis result from this practice.

4. In surgical work the artery forceps is the most satisfactory means of preventing or arresting hæmorrhage. When vessels are seen in the course of a dissection they should be clamped on either side before they are divided. Much time can be saved in an ordinary surgical operation by having a large number of artery forceps. Many of these applied to bleeding points produce coagulation in the vessels before the operation is ended, and the application of a ligature is unnecessary. In this way much time can be saved. Other vessels will have to be secured, and modern experience teaches us that carefully sterilized catgut is perfectly safe, and the most satisfactory of all ligature materials.

5. Torsion or twisting. By this method the divided ends of an artery are seized by the forceps and twisted round and round three or four revolutions, and the forceps unclasped and removed. The mechanism of occlusion is the destruction of the elastic and epithelial layers of the vessel, while the connective-tissue sheath and the adventitia are twisted into a fine thread which does not unwind after the forceps have been removed, and the vessel is thoroughly occluded. Torsion answers well in the case of small arteries.

6. Acupressure is practically obsolete in modern surgery. It consists in running a needle or a long silver or metal pin underneath the vessel to be compressed, and throwing a figure-of-eight thread over the two exposed ends of the needle.

7. The ligature is the chief reliance of the surgeon. In ligation of the larger arteries—the subclavians, carotids, iliacs, and femorals—large-sized catgut (No. 3 or No. 4) is preferable. In tying the exposed ends of a divided artery it is advisable to seize the end with a dissecting forceps and, with a dull instrument, preferably a grooved director, dissect back the sheath and whatever fat and connective and other tissue overlaps the end of it, so that the ligature may be properly applied to the clean vessel wall. In tightening the ligature it is not necessary to use such pressure that even the endothelial and elastic coat are divided; but the walls should be snugly brought into contact, and it is well enough, when the first knot is run down and tied, to leave both ends of the ligature perfectly slack, until the second and even the third knots are run down and secured. If after the first knot is tied the operator pulls or makes tension on either end of the ligature, he will be apt to loosen it at the point of constriction, and he may thus tie the finishing knot without having occluded the vessel. The theory was advanced by Scarpa many years ago, and was demonstrated by myself in 1880,

and in the later classical work of Ballance and Edmunds, that the process of occlusion after deligation of arteries was by proliferation of the endothelia and connective-tissue cells of the vessel and the well-known process of cicatrization, following inflammation in all the soft structures of the body, and that the formation of a clot was not at all essential to permanent occlusion.

Many surgeons still use silk as a ligature, and others have substituted numerous ligatures other than catgut, such as ox aorta (Barwell), deer sinew (Wragg), and sterilized nerve tissue (used in a number of deligations by the author). I have tied the larger arteries many times with catgut, and have never yet seen a secondary hæmorrhage, and see no reason why any other substance should be substituted for this excellent material. The few accidents which have been recorded were in all probability due either to an inferior article, which introduced septic matter into the wound and set up inflammation and suppuration, or to the vessel being tied over-tight, weakening the walls, which gave way under the action of the heart.

In applying a ligature to an artery at a point remote from the point of lesion—that is, to an undivided artery—the vessel should be exposed and its sheath carefully picked up by the forceps and nicked, so that the aneurysm needle (or the silver probe, which can be used for this purpose when no aneurysm needle is at hand), may be inserted between the sheath and the walls of the vessel, and made to pass around it; the artery, being thus exposed, can be tied as heretofore advised. It is the practice of many good surgeons to apply two ligatures when a vessel is tied in continuity, half or three quarters of an inch apart, opening the sheath continuously for this purpose, and then dividing the artery midway between the two ligatures. I have never employed this method and do not see the necessity for it. It is held by some, however, that there is less likelihood of secondary hæmorrhage if the natural longitudinal tension of the vessel is relieved by its division, both ends retracting into their sheaths, as they do in division in ordinary wounds. All ligature material should be absolutely sterile when employed.

8. Heat, either in the form of the actual cautery or in that of water heated to from 120° to 140° F., is a very excellent hæmostatic under certain conditions. Demonstrations of the value of the actual cautery are seen in the ordinary operation for hæmorrhoids with the clamp and cautery. In large oozing surfaces, compression with towels dipped in hot water is an excellent means of stopping capillary hæmorrhage.

9. Cold, in the shape of ice or very cold water, is not so valuable a hæmostatic as heat, but acts in the same way, by exciting contraction of the non-striated muscle fibres.

10. Styptics, such as persulphate of iron, are sometimes employed, but it is difficult to understand under what conditions their use would be justified.

Dr. Roswell Park, of Buffalo, has pointed out the advantage of a solution of antipyrine in controlling hæmorrhage, especially over the small vessels in the pia mater. It is sterile and does not interfere with prompt healing, and causes contraction of the vessels, but not coagulation of escaped blood. It is applied as a spray.

Gallic and tannic acids may also be mentioned, but, like the iron salts, they are not to be employed when compression or heat or cold can be used.

It may be well to mention the action of certain well-known internal remedies, which cause arterial contraction or lessen the heart's force, and may occasionally be of service in arresting bleeding.

11. In amputations where extensive muscular masses are cut across, as in the thigh or hip, and where oozing is always troublesome, it is advisable to pass deep sutures of strong catgut through the muscles in various directions, tying them, and thus exercising firm compression upon bleeding capillaries and even larger vessels, which otherwise would require separate ligatures and much valuable time.

12. Ligation of the extremities. One of the most difficult forms of hæmorrhage to control is that occurring within one of the cavities of the body, especially in the cranial and thoracic cavities. Intraperitoneal wounds are almost always amenable to direct interference by abdominal section and the application of the ligature to the bleeding point. But this is not always true, especially in certain conditions of shock, where the surgeon may doubt the propriety of operative interference. In wounds of the lungs and in pulmonary hæmorrhage from any cause direct hæmostasis is practically impossible.

Under any condition of hæmorrhage in any of the cavities of the body where direct interference can not be employed it should be the aim of the surgeon to diminish the blood-pressure at the bleeding point. To this end the application of ligatures upon the extremities of the body at the shoulders and at the hip joint may be efficacious. They should be just tight enough to interfere with the return of blood in the veins, yet not sufficiently tight to occlude the artery, for the blood must flow out through the arteries and be prevented from returning by the pressure of the ligatures on the more yielding veins, in order to fill the tissues of the extremities with blood and thus hold that much of the circulating fluid in reserve until the hæmorrhage can be arrested by coagulation at the point of bleeding. It may be safely assumed that one third of the entire volume of blood may thus be held in abeyance. The danger of shutting off too much blood in this way and producing cerebral anæmia or heart failure, from the lack of volume of blood upon which the heart may act, must not be forgotten, and this must be determined by the case under treatment. The ligatures may be left on fifteen or twenty or as many as thirty minutes, and when they are removed it should be done gradually, since the return of the blood which has been imprisoned in the extremities might so suddenly increase the volume in the vessels,

the heart's action being likewise increased, that the coagula might be forced out of the vessels at the point of hæmorrhage.

Even so short a sketch of hæmostasis as this should not be concluded without insisting upon the value of the injection of hot saline solution in cases of hæmorrhage. To make this, take ordinary water which has been boiled for purposes of purification and allowed to cool to 110° or 120° F., at which temperature it is just about as hot as the hand can comfortably bear, and to a quart of this add an ordinary level-filled teaspoonful of salt. The water should be kept warm while being used, since, if it is allowed to run in cold, it will extract animal heat from the body, but when used warm it will add heat to the body, which, of course, is of benefit. It can be thrown in through an open vein, or a vein can be opened in the arm and an ordinary pipette introduced into it, the other end being attached to the tube of a fountain syringe. Care must be taken to prevent the ingress of air into the vein by filling the pipette, which has been introduced into the vein, with the hot solution before the finger has been removed from the compressed vein between the pipette and the heart, and then allowing the fluid to run through the rubber tubing. As soon as it escapes freely the tubing may be closed with the finger and thumb about a foot from the point of connection and then attached to the pipette. All air is thus excluded. The quantity to be employed may be varied as the heart's action demands. I have used as much as five pints in a single operation where there was great hæmorrhage. It will be observed that after from half a pint to a pint has been allowed to flow in the pulse will fall from 120 or 140 to 100 or 80, and this should be the criterion, since the rapidity of the action of the heart is due to the lack of volume of blood it has to act upon. In parturition, where the patient is exhausted from profuse hæmorrhage, five or six pints or more may at times be required.—John A. Wyeth.

HAMAMELIS, or witch hazel, consists of the leaves or bark of *Hamamelis virginiana*, a North American shrub, growing east of the Mississippi River. The long leaves, which should be collected when the twigs are flowering in autumn, have a tea-like odour and an astringent, bitter taste. The fresh leaves, *hamamelis*, are used to prepare the fluid extract, *extractum hamamelidis fluidum* (U. S. Ph.). The dose is 30 minims. It is used as an *astringent* and *hæmostatic* in hæmorrhages and hæmorrhoids.

Hamamelis contains about 10 per cent. of *tannic acid.* It also has odorous and bitter extractives, a trace of oil, and an active principle whose physiological properties have not been fully determined. Wood, of Philadelphia, and Guy, of Paris, have injected large amounts of a very concentrated distillate of hamamelis into mammals and frogs, producing effects which did not differ from those of similar injections of distilled water.

The American Indians have long used witch hazel as a sedative. A proprietary extract, said to be made by distilling the bark in 6-per-cent. alcohol, has been a very popular household remedy for external application, with friction, to *sprains* and *bruises*, and for the internal medication of numerous ailments. Hamamelis has been used as a tonic and as a vulnerary, but it seems probable that its virtues are those of an astringent, with a possible hæmostatic action. The latter property is doubted by many.

The local astringent effect of the tannic acid in hamamelis is to coagulate the tissue-albumin, and to constringe the connective tissue so that the calibre of superficial vessels is lessened, thus diminishing *secretions* and passive hæmorrhages of leucocytes and plasma. It thus has a local *styptic* effect in active *hæmorrhages*, coagulating the blood and constringing the tissues. Wounds, ulcers, and oozing areas have their broken surfaces tanned, and their secretions coagulated and disinfected. *Peristalsis* and the secretions of *enteritis* are checked.

The *hæmostatic* and astringent effects of the application of hamamelis to *hæmorrhoids* gives partial relief in many cases. The bleeding is stopped, the piles are constringed to a smaller size, and the cleansing and disinfectant actions of the lotion or ointment are of considerable benefit. In *varicose veins* and other forms of venous dilatation and engorgement, hamamelis has been given internally with varying effects.

Witch hazel may be used internally as a hæmostatic for *hæmorrhoids*, *pulmonary*, *renal*, and *uterine hæmorrhage*, *purpura*, and *hæmatemesis.* It may be used in *gastric catarrh*, *diarrhœa*, *dysentery*, *chronic bronchitis*, and the *colliquative sweating of phthisis.*

Hamamelis may be used externally for *piles*, *superficial hæmorrhage from small wounds*, *epistaxis*, *bleeding from the mouth*, *throat*, *anus*, or *vulva*, or *discharges from the skin*, *ears*, *nose*, *eyes*, *urethra*, *vagina*, *uterus*, or *rectum;* to harden *chapped nipples* and *tender feet*, to check *catarrh* and *oozings*, and as a mouth gargle in *chronic sore throat.* The alcohol in the tinctures and the friction used in applying them are the probable causes of relief in sprains and bruises.

HARTSHORN. — See under Ammonium carbonate.

HEADINE.—This name has been given to an English proprietary preparation said to consist of acetanilide and sodium bicarbonate.

HEAT as a therapeutic agent depends for its activity upon a number of factors, and these vary with the method of application and with the temperature employed. A profound action upon the circulation follows the external or internal application of heat, whatever its form. If the heat is considerable in amount and the area of application sufficient, the heart's action is made more rapid and more forcible, but a secondary weakening will occur if the application is too long continued or the heat too great, and in the latter case heat-stroke may follow. That heat is thus a stimulant of much value is proved by the success which follows its employment in conditions of *exhaustion* and *shock*,

but the circulatory enfeeblement which may secondarily result is shown by the syncope occurring not rarely in those who too long subject themselves to the heat of the Turkish or Russian bath. Besides the cardiac action of high temperature, its action upon the blood-vessels is an important one. If the heat is moderate there occurs in the area to which the application is made a relaxation of all the tissues, the vessels included. It is for this reason that the part heated becomes reddened, and that from it an increased perspiration takes place. Such an effect is seen from the general exposure to heat which takes place in the hot-air bath, as well as from the application of heat locally, and from the use of hot drinks a similar result is observed in the general cutaneous hyperæmia which they cause. If the heat, when locally applied, is extreme, however, no such hyperæmia takes place, but instead there is present a diminution of the blood in the parts, as is exemplified in the pelvic bloodlessness resulting from the use of very hot vaginal douches, as well as in the hæmostatic action of very hot applications. To these actions should be added the power of substitution possessed by heat in algid states. An example of this may be witnessed in the symptoms and phenomena of coldness which collapse presents, and the well-known benefit which results in such cases when heat is employed. And, finally, heat has a further action to destroy tissues when applied in great intensity. Though the chemical escharotics no doubt are oftener employed, the hot iron as a therapeutic agent is none the less effective. Counter-irritation, too, however its action is to be explained, certainly is most efficiently accomplished by heat. Heat is thus active medicinally by virtue of a number of physiological actions.

It will best serve my purpose to consider the therapeutics of heat as based upon its physiological actions, mentioning under each physiological division the morbid conditions which may be relieved by heat and the manner in which its action is to be elicited.

As a cardiac stimulant heat is a valuable accessory to medicinal stimulation, and in fact there are many conditions of circulatory enfeeblement in which it is the more active agent of the two. Thus may be treated *shock, collapse, exhaustion, drowning, narcotic poisoning,* and allied conditions. As a means to accomplish the end, heat, however applied, will be indicated. The more usual means are hot drinks, hot enemata, the hot bath, the application of heated cloths, hot-water bags and bottles, hot bricks or sand bags, and the use of friction.

To supply heat to the body in *algid states* the same means may be employed, but it must not be supposed that the mere covering of a patient in the algid state with clothing will give back to him the heat he has lost. On the contrary, a positive heat supply is necessary, and from protection by coverings nothing more can be expected than a prevention of further heat dissipation. These algid states are many of them included in the list given in the last paragraph, but to these may be added exposure, provided it does not reach the point of freezing, when, as is well known, heat is contraindicated; chilling from any cause—submersion, for example; and the algid states of such diseases as *cholera.* In the algidity of *hæmorrhage,* however, heat must be most cautiously employed, lest with the resultant stimulation of circulation the hæmorrhage be revived.

To promote perspiration and thus to favour elimination is one of the most important applications of heat. No more perfect example can be had of this than the action of the hot-air bath in *kidney diseases* or *uræmia,* though the Turkish bath is in like manner, if less decidedly, effective. The production of diaphoresis is effective too in the abortion or removal of inflammatory conditions within the body, and the internal and external employment of heat to cause the familiar "sweat," an efficacious procedure in such conditions as *coryza, bronchitis,* and *muscular rheumatism,* is well known.

The constringing and contracting of tissues is accomplished by heat as it is by cold. There seems good reason to believe that the contraction due to heat is more lasting than that due to cold, and, moreover, heat is applicable for this object where cold might not be, as is exemplified in the vaginal douche. In hæmorrhage which can be directly reached and acted upon by heat this action is invaluable, but it must be heat and not warmth which is used, for warmth, so far from contracting tissues, will but relax them, and thus increase the bleeding. In *pelvic congestion* hot vaginal douches are beneficial, and for *sprains* no immediate treatment is superior to prolonged soaking of the injured part in water as hot as can be borne.

Relaxation of the tissues is accomplished by warmth rather than by heat, and if the warmth is associated with moisture the effect is heightened. Of such a combination the poultice is an example, and its indications are too familiar to need detailed consideration. That such applications are anodyne, too, is beyond doubt, but simply by virtue of the relaxation they produce. The inhalation of warm steam in *inflammatory conditions of the throat,* the application of warmth to the neck in *laryngismus stridulus,* the lessening of *colic* by fomentations, and even the quieting of *choreic movements* by the warm pack, are examples of this relaxation.

To determine a flow of blood away from temporarily congested areas is well accomplished by heat, for nothing could be more striking than the benefit observed in *infantile convulsions* when a hot bath is given, unless it is the relief in *congestive dysmenorrhœa* which comes from the hot foot-bath.

The softening effect of heat upon skins chronically diseased is well known, though it is usually warmth rather than heat which is employed, and warmth and moisture in particular. The Turkish bath and the Russian bath are thus active, as well as a vast number of medicinal baths, of which it is probable that warmth and moisture represent the sole or at least the most important factors. Hot appli-

cations are sometimes most beneficial for the relief of *itching*, and hot baths are serviceable in hastening the development of eruptions.

Hot applications by stimulating the local circulation are effective in promoting absorption of *inflammatory exudations*, and the hot douche, especially if used in alternation with the cold douche, is of much benefit in such cases, as is exemplified by *chronic articular thickening* and *adhesion*.

That heat is a counter-irritant is of course true, and poultices no doubt owe their action not alone to relaxation but also to counter-irritation. The actual cautery, when used to the degree of producing erythema, is a more perfect example of this, however, as is also the production of a blister by heat. (See also under Germicides, page 443.)

[Heat applied over certain regions of the spinal column seems to act as a stimulant to the underlying portions of the spinal cord and thus to reduce congestion of organs whose nerve supply comes from those areas of the cord. A familiar example is the reduction of *pelvic congestion* and the control of *menorrhagia* and *metrorrhagia* by the application of a hot-water bag over the junction of the dorsal and lumbar portions of the spine.]

Henry A. Griffin.

HEDEOMA (U. S. Ph.), the leaves and tops of *Hedeoma pulegioides*, an American variety of pennyroyal, is aromatic and carminative. The volatile oil, *oleum hedeomæ* (U. S. Ph.), may be given in doses of from 2 to 10 drops in *colic* and *nausea*.

HELENIN, HELENIUM.—See under Inula.

HELLEBORE, AMERICAN.—See Veratrum viride.

HELLEBORE, BLACK.—The *Helleborus niger*, a ranunculaceous plant indigenous to central and southern Europe, is little used in medicine at the present day, because of its irritating properties and of its harsh poisonous effects.

The *Ranunculaceæ* are distinguished by the fact that all of them contain, when fresh, a peculiar acrid sap or juice which is so irritating to the mucous membranes that they are avoided by grazing cattle, although when mixed in hay and thoroughly dried they are eaten with apparent indifference. The acrid matter either evaporates or is so modified in the process of drying as to lose its irritating power.

The parts of the black hellebore that are used in medicine are the rhizome, or root-stalk, and the rootlets. Besides starch, resin, and other ordinary vegetable matters, they contain certain specific compounds, among which there are two, *helleborin* and *helleborein*, that have been separated and found to be almost if not quite identical with the two active constituents of green hellebore, *Veratrum viride*. I allude to this in order to direct attention to the somewhat confusing nomenclature which may possibly be a source of error.

While both black and green hellebore contain these two constituents, *helleborin* and *helleborein*, they do not contain them in the same quantities, absolutely or relatively, and therefore their physiological action is not the same. We should also remember that the white hellebore contains neither of them, but has its own active principles, and can not be satisfactorily substituted for them unless in an emergency, when, in small doses, it might replace *Veratrum viride*, or green hellebore, as a cardiac and spinal sedative.

And, further, we should remember that *veratrine*, the great sedative alkaloid, is not derived from *Veratrum viride*, nor from the *white hellebore*, *Veratrum album*, as its name would suggest, but from *sabadilla*, a Mexican plant of the *Melanthaceæ*, and it was thought at the time of its discovery to be identical with an alkaloid obtained from *Veratrum album*.

The physiological action of black hellebore is distinctly dual, depending as it does on the presence of the two glucosides, *helleborein* and *helleborin*. The former is an irritant to the mucous membrane of the entire alimentary tract, the kidneys, and other glandular organs, at the same time exerting a profoundly poisonous influence upon the circulatory and respiratory apparatus. The latter is a powerful narcotic and depressant to the cerebrospinal system.

As the result of the combination of two such potent agents we see the ingestion of moderate doses of black hellebore—say from 15 to 20 grains of the powder—followed by warmth or even burning in the stomach, with a tendency to nausea, more or less pronounced in accordance with the size of the dose and the susceptibility of the subject; and catharsis, which is not a typical symptom, although there is always decided irritation of the entire intestine, even to the extent of producing the secretion of a great quantity of sanguinolent serum and mucus. The absence of stools in some cases of poisoning is probably due to paresis of the muscular coat of the intestine. Further irritative symptoms are diuresis, followed in some cases by suppression of urine, owing to the exaggerated hyperæmia, hæmaturia, and albuminuria, with disturbance of the cardiac and respiratory functions. If the dose is small or moderate, the pulse is slower and stronger, showing an effect which closely resembles that of digitalis, but after larger doses the heart's action becomes exceedingly rapid and feeble, while the respiration is slow and laboured, and so continues until after the heart has ceased to beat. The nervous symptoms are a feeling of fulness in the head, vertigo, pains in various parts of the body, and, if a lethal dose has been taken, stupor ending in convulsions.

There is no special antidote, the treatment in case of poisoning consisting in the use of measures for the simple maintenance of life, together with such efforts as suggest themselves to the physician as of use in relieving the symptoms. The stomach should be emptied if free vomiting has not already occurred.

[Black hellebore has very properly been dropped from the pharmacopœias. It is a violent hydragogue cathartic, and is said to

be emmenagogue. The dose of the powdered root is from 5 to 15 grains.]

BENJAMIN F. WESTBROOK.

HELLEBORE, GREEN.—See VERATRUM VIRIDE.

HELLEBORE, WHITE.—*Helleborus albus*, or *Veratrum album*, is a plant of the natural order *Melanthaceæ*, growing throughout the southern portion of Europe, on the borders of the Mediterranean, and recently discovered in California and Colorado. It is little used in modern medicine, although it is official in the Ger. Ph. as *rhizoma veratri* and in the preparation *tinctura veratri;* indeed, is not to be recommended excepting in an emergency, when the more valuable *Veratrum viride*, or the alkaloid veratrine, is not available.

Like the other plants of this order, *Veratrum viride* and the Mexican sabadilla, from the latter of which the alkaloid veratrine is obtained, its action is twofold. In the first place, and as regards its local action on the primæ viæ, it is intensely irritant, producing, in small doses, heat or burning in the mouth, œsophagus, and stomach; in larger amounts, the most violent irritation in these parts, together with diffuse abdominal pain, with burning and distress in the region of the sacrum. To this are added thirst, salivation, increased secretion of the gastric and intestinal juices, nausea, vomiting, and sometimes purging.* Secondly, its action upon the nervous system is profound and, like that upon the alimentary canal, of such a character as to indicate extreme danger in its careless administration. The symptoms refer both to the cerebro-spinal axis and to the sympathetic and splanchnic systems; in fact, the apparently local phenomena may be, and are mostly, due to its effects on the nervous apparatus, as the symptoms may all follow upon its hypodermic injection.

The obviously nervous symptoms are pallor, faintness, vertigo, great muscular weakness, with a sensation of stiffness in the limbs, cold sweat, dilated pupils, dull headache (perhaps from cerebral anæmia), dimness of vision, diminished arterial pressure, disturbance of the urinary secretion, which may be increased or diminished in accordance with the dose and the idiosyncrasy of the patient, and, when the dose is lethal, unconsciousness with convulsions.

The greater violence of the action of *Veratrum album*, as compared with that of *Veratrum viride*, appears to be due to the fact that its active principle, instead of being the same, is an alkaloid called by its discoverer, Mr. C. L. Mitchell, *veratralbine*, much more irritating in its effects than *veratrine*.

The therapeutic indications for the white hellebore are the same as for veratrine or *Veratrum viride*. It is probable that very small doses would be of use in *sthenic febrile conditions*, such as *acute crupous pneumonia*, *acute pleurisy*, and the active febrile and inflammatory states generally.

It might even be used, as Norwood used *Veratrum viride*, in *acute gastritis*, if the doses were sufficiently minute; or even in *acute pericarditis*, as has been recommended. But in such case the quantity administered should be not over ¼ or ½ of a grain of the powdered root, or, better still, from 3 to 5 minims of the wine of the Lond. Ph. Either of these small doses might be used once in two hours with safety. The main point in its use is to secure arterial sedation, diaphoresis, a moderate increase of the mucous glandular secretions, and subduction of cerebro-spinal irritation.

This drug has been used for the destruction of *lice*, the *itch mite*, etc., and is very efficacious; but it is not recommended, on account of the dangers from its absorption, especially through the delicate and highly vascular skin of young children.—BENJAMIN F. WESTBROOK.

HELLEBOREIN, HELLEBORIN.—See under HELLEBORE, BLACK, and HELLEBORE, WHITE.

HELLEBORUS ALBUS.—See HELLEBORE, WHITE.

HELLEBORUS NIGER.—See HELLEBORE, BLACK.

HEMIDESMUS, *hemidesmi radix* (Br. Ph.), Indian sarsaparilla, the dried root of *Hemidesmus indicus*, has been used as a tonic, antisyphilitic, diuretic, and diaphoretic. The dose of the syrup, *syrupus hemidesmi* (Br. Ph.), is 1 fl. drachm.

HEMLOCK.—See CICUTA and CONIUM.

HEMP.—See APOCYNUM and CANNABIS INDICA.

HENBANE.—See HYOSCYAMUS.

HEPATICS are measures which directly or indirectly act on the liver. The cholagogues stimulate the production or excretion of bile; the hydragogues deplete the portal vein; the diuretics remove urea; and the diabetics control nutrition and the excretion of sugar.

The liver cells act upon the blood from the portal vein to form bile, urea, and glycogen. An excess of rich food, especially of meats and alcohol, will overwork and disorder the liver, indicating that the *diet* should be adapted to the needs of the system. Luxurious living in warm climates and sedentary occupations in poorly ventilated rooms will prevent the liver cells from receiving enough oxygen from the blood of the hepatic artery. The cool air of fields, parks, or well-ventilated rooms, and *outdoor exercise* have decided tonic effects on the liver by promoting an increased vital action of every tissue. Inactive bowels, kidneys, lungs, or skin may cause the products of the liver to be retained and so weaken its action. The necessary complete excretion may be brought about by stimulating the intestinal, renal, pulmonary, or cutaneous functions.

A disordered liver secretes a bile which is so impaired as to have lost its normal peristaltic effect upon the muscular coats of the intestines,

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* Purging as a symptom is not mentioned by the older writers or by Woodman and Tidy in their work on *Toxicology*. But H. C. Wood refers to it, and it is also alluded to by Stillé and Maisch (*Nat. Dispens.*) as occurring after prolonged administration of the drug.

and this results in constipation. The normal antiseptic effect of the bile upon the intestinal contents is also lost. The latter ferment into the gases of flatulence, and into irritant poisons which set up a diarrhœa with foul, pale fæces. The light colour of the latter is due to the absence of normal bile pigments, which may be found in the dark urine.

In jaundice the skin, the whites of the eyes, and the other tissues are coloured yellow by bile pigments, formed in the liver cells but forced to enter the blood in such great quantity that the urine can not remove them. In the obstructive form the bile has been so thickened as to plug the inflamed ducts with inspissated bile, and the resulting distended gall bladder, indicated by a tender hepatic area, has probably allowed the formation of biliary calculi. The occasional passage of these gallstones causes the severe pain of biliary colic. An excess of bile poured into the duodenum causes bilious diarrhœa.

The symptoms of "*biliousness*" are due to the circulation in the blood of products of disordered metabolism. These include many abnormal toxines as well as an excess of such normal products as urea and uric acid. They so affect the nervous centres as to cause lassitude, sleepiness, headache, irritable temper, depression, and melancholy. These poisons produce muscular debility, with aches, fatigue, flabbiness, and tremors. The effect on the general nutrition, together with the loss of the digestive action of the bile, may result in emaciation. The deranged circulation causes palpitation and flushing. At length the heart and vessels may become diseased, causing gout in the joints and skin. The overworked renal excretion may produce lithæmia and renal or vesical calculi.

In *diabetes* the glycogen-forming and glycogen-storing functions of the liver are so deranged that sugar appears in the blood, the tissues, and the increased urine. Thirst, hunger, and wasting are the chief symptoms. In some cases the hepatic centre in the brain may be injured. The sugar disappears from the urine under the administration of codeine and the removal of starches and sugars from the diet.

Among the direct cholagogues which stimulate the secretion of bile are ipecac, rhubarb, podophyllum, aloes, corrosive sublimate not decomposed into calomel, colocynth, sodium phosphate and sulphate, ammonium phosphate, euonymin, iris, jalap, scammony, and benzoic acid; the mineral acids and sodium bicarbonate, which increase the glycogen; arsenic, which lessens the glycogen; antimony, which lessens the glycogen but increases the urea; and colchicum, which diminishes the urea.

The indirect cholagogues act by sweeping the bile from the duodenum, and thus in a reflex way from the biliary ducts and gall bladder. They include calomel, other mercurials, and the cathartic purgatives. These are generally followed by hydragogues to evacuate the bowels and deplete the portal vein. Olive oil is used in the removal of biliary calculi. Acetate of lead and intestinal irritants decrease the bile. Nitrite of amyl and bicarbonate of sodium increase the glycogen. Opium and morphine diminish the bile, the glycogen, and the urea. Phosphorus and chloride of ammonium lessen the glycogen but increase the urea. Alcohol, quinine, tea, and coffee relieve bilious depression but diminish the urea.

HEXAMETHYLENETETRAMINE.—See Urotropine.

HIDROTICS.—See Diaphoretics.

HIRUDO.—The leech. See Leeching.

HIVE SYRUP.—See under Squill.

HOANG-NAN, the bark of *Strychnos gaultheriana*, contains strychnine and brucine. Besides its use in cases in which strychnine is indicated, it has been thought efficient in *rabies*, *leprosy*, and *scrofula*. The powder may be given in daily amounts of 10 grains, in divided doses.

HOMATROPINE is an alkaloid obtained by splitting atropine or hyoscyamine into tropine and tropic acid, and then evaporating a mixture of tropine and mandelic or amygdalic acid with dilute hydrochloric acid. The alkaloid thus obtained is in transparent, colourless, regular crystals, not very soluble in water, but nevertheless hygroscopic and very deliquescent. It is soluble in oil, but its salts are not.

The salicylate and hydrochloride have been used to a slight extent in medicine, but the hydrobromide, *homatropinum hydrobromicum* (Ger. Ph.), is the salt most commonly employed. This salt occurs in a crystalline powder or in large, wart-like aggregations of crystals or rhombic prisms with irregularly developed pyramidal surfaces, is not hygroscopic, dissolves in from 6 to 10 parts of water and in 133 parts of ethyl alcohol. Its solutions do not readily undergo any change.

The physiological symptoms produced by homatropine are very similar to those produced by atropine, with the exception that the frequency of the pulse-beat is lessened instead of increased, and that this is accompanied by a diminution of the arterial pressure. Whether this result is due to the action of the drug upon the spinal cord or to its direct action upon either the muscular tissue of the heart or its contained ganglia is still a moot point with physiologists. No fatal cases of poisoning have occurred from the medicinal use of this drug, and no toxic symptoms have been reported beyond a slight drowsiness, but in the lower animals death results, after an overdose, from paralysis of the respiratory centres.

In general medicine homatropine has been used to check the *night sweats of phthisis*, and the dose for internal administration is from $\frac{1}{80}$ to $\frac{1}{20}$ of a grain, but practically it is used only in ophthalmology, and there for only one purpose—to dilate the pupil and paralyze the accommodation for the purpose of correcting a *refractive error*. For this purpose it has three decided advantages over most other mydriatics—its prompt action, its transitory effect, and the practical absence of danger of systemic poisoning. The mydriatic effect begins in from ten to twenty minutes after the first instillation, is usually complete in about an

hour, and lasts from a day and a half to three days. This promptness of action enables the physician to begin the examination of the eye in about an hour from the first instillation, and its transitory effect permits the final examination to be made two or three days later. These advantages will be appreciated when its action is compared with the mydriatic action of atropine, which requires three or four instillations a day for four or five days to produce complete paralysis of the accommodation, and from ten to fourteen more for recovery sufficient to allow of the final examination of the eye. In exceptional cases the mydriatic effect of homatropine may last four days, or even longer, but it very rarely if ever lasts as long as the usual mydriasis of hyoscyamine—eight or nine days.

One writer, Stewart, has maintained that repeated instillations of homatropine irritate the conjunctiva and also the deeper tunics of the eye, that single instillations of less than $\frac{1}{15}$ of a grain are valueless for the purpose of estimating ametropia, and that in consequence the use of this drug should be avoided in the correction of refractive errors and its use restricted to dilating the pupil for ophthalmoscopic examination. Hyperæmia of the conjunctiva is doubtless caused by homatropine, though this seems to be less marked than formerly, probably on account of some improvement in the process of manufacture, but as regards the irritation of the deeper tunics of the eye, if this is true, it seems strange that such an effect should be continually overlooked by the large number of ophthalmologists who are accustomed to use the drug quite freely, and also that no cases have been reported, at least to the writer's knowledge, showing the lighting up of new or the rekindling of old inflammation in the deeper tunics of the eye. The one danger to the eye from the use of homatropine is that attaching to all mydriatics, the danger of exciting glaucoma. Regarding this, homatropine possesses no advantage except that of brief duration of effect. Harlan reports a case in which transient pulsation of the retinal arteries was repeatedly produced by the instillation of a solution into the conjunctival sac.

There is considerable difference of opinion as to the reliability of homatropine to produce complete paralysis of the accommodation. A watery solution of the hydrobromide, 4 grains to the ounce, is usually employed, one drop to be instilled into the conjunctival sac every five to fifteen minutes until the full effect is produced. In the majority of cases complete ciliary paralysis will be obtained after this has been persisted in for an hour or an hour and a half, but in a rather small minority of cases the result will be only a partial paralysis. Some authors recommend the use of a solution of from 10 to 16 grains to the ounce in the same manner, and state that there is no question as to the reliability of its action when used in this strength.

Lang recommends a solution of the uncombined alkaloids cocaine and homatropine, each 2 per cent., in castor oil, but its advantage over the watery solution is not very apparent.

Gelatin discs containing either the uncombined alkaloid or the hydrobromide in various strengths, with and without the addition of cocaine, are used to a considerable extent and are very convenient, but they certainly increase the tendency of this drug to irritate the conjunctiva.

To dilate the pupil for ophthalmoscopic purposes one drop of a watery solution, 1 grain to the ounce, is sufficient and causes little inconvenience, but for this purpose cocaine has in a great measure superseded the drug now under consideration.

For therapeutic use in ophthalmic work homatropine possesses no advantages over atropine, and labours under the disadvantages of briefness of action and a tendency to induce hyperæmia of the conjunctiva. In *incipient cataract* Risley recommends the moderate use of homatropine as preferable to that of the other mydriatics, especially in cases where there is discomfort without increase of the intra-ocular tension.

MATTHIAS LANCKTON FOSTER.

HONEY, *mel* (U. S. Ph., Br. Ph.).—Toxic symptoms have been reported as following the use of honey made by bees that had fed on the flowers of gelsemium, stramonium, and some other plants. Chemically, honey consists of from 37 to 40 per cent. of lævulose, from 31 to 42 per cent. of glucose, and wax, pollen, insoluble matter, and water. While the fruit sugar remains liquid, in old honey the glucose is likely to crystallize and convert the substance into a soft, granular mass. Strained honey is frequently adulterated with glucose, and it is said that the latter substance is placed by some apiary keepers in the vicinity of hives in order that the bees may use it.

To some people honey is slightly laxative; it may be used as a vehicle for gargles; it was formerly used as an application to ulcers, though such treatment is obsolete. Von Ziemmsen recommended a paste composed of honey mixed with rye meal as an application in abscess of the ear.

Clarified honey, *mel despumatum* (U. S. Ph.), *mel depuratum* (Br. Ph., Ger. Ph.), is prepared by mixing intimately honey and glycerin with 2 per cent. of their weight of thoroughly washed and shredded paper pulp. The mixture is heated in a water bath, the scum is carefully removed as it rises to the surface, and when this latter ceases sufficient water is added to make up the loss incurred by evaporation, the mixture is strained, and there is added to the strained liquor 5 per cent. of its weight of glycerin. It is used as a menstruum.

SAMUEL T. ARMSTRONG.

HOPS.—See HUMULUS and LUPULIN.

HORDEUM (U. S. Ph., 1870), barley, *hordeum decorticatum* (Br. Ph.), pearl barley, is the dried seed of *Hordeum distichon* divested of its integuments. Only cultivated British plants are recognised by the Br. Ph. Pearl barley (*hordeum perlatum*) is a commercial name; as the grain thus denominated appears in commerce, it is not only deprived of its investments, but is rounded and polished. Thus prepared, the

individual grains are round or oval, are of pearly whiteness, and have a remnant of the longitudinal furrow which marks the seed in its natural state. The taste and odour are farinaceous. This is the barley invariably to be employed in medicine. Its most important constituents are starch, gluten, sugar, and gum. Barley as such is but infrequently used in medicine, but it is the source of malt, from which material a large number of the so-called malt liquors are prepared, as well as malt preparations in general, and the ferment called diastase. This malt is merely barley which, because of its exposure to warmth and moisture, has begun to germinate, the process, however, having been cut short by the employment of heat sufficient to kill the grains. (See MALT.)

Although the therapeutics of barley is small, and the grain in substance is not medicinal, a decoction is highly beneficial as a nutritive demulcent. This is useful in conditions of *gastric* and *intestinal irritation* and *inflammation*. In *fevers* and in *inflammatory states* other than those of the digestive tract this decoction is also employed at times as a demulcent drink, and certainly the service which it may thus render has abundant testimony in its favour, for the practice has persisted from the earliest times. A decoction of hordeum (barley water) was official in the U. S. Ph. of 1870, which directed that 2 troy oz. of barley be thoroughly washed and boiled for a short time with half a pint of water, then this liquid thrown away, and finally 4 pints of boiling water to be added to the barley and be boiled to 2 pints and strained. The directions for making the British decoction of barley, *decoctum hordei* (Br. Ph.), are as follows: "Take of pearl barley 2 oz., distilled water 1½ pint. Wash the barley in cold water, and reject the washings; boil the washed barley with the distilled water for twenty minutes in a covered vessel, and strain. Product, about 1 pint." The dose is from 1 to 4 fl. oz.

HENRY A. GRIFFIN.

HOREHOUND, *marrubium* (U. S. Ph.), the leaves and tops of *Marrubium vulgare*, has been employed as a bitter tonic, stomachic, expectorant, diaphoretic, diuretic, and laxative; the latter effect is produced by the administration of large doses, and a hot infusion causes diaphoresis and some diuresis. It is a popular remedy in *colds*, *catarrhal bronchitis*, *sore throat*, and *chronic pulmonary disorders*, but beyond a slight expectorant effect it has no characteristic action. An infusion prepared with 1 oz. to a pint of boiling water may be taken in wineglassful doses *pro re nata*. The powder contains too much inert matter to make its administration advisable. An unofficial fluid extract prepared from the leaves is given in doses of from 1 to 2 fl. drachms.

SAMUEL T. ARMSTRONG.

HORSERADISH, *armoraciæ radix* (Br. Ph.), the root of *Cochlearia armoracia*, is largely employed as a condiment. To obtain it in its most perfect state it should be of only one year's growth, as, if it is allowed to remain in the ground for a longer period, it becomes stringy and hollow. Also the fresh root is the most desirable for medicinal use, as the oil which contains the major portion of its active principle soon volatilizes. The effects of this oil closely resemble those of oil of mustard. It is highly irritating to the mucous membranes, and causes lacrymation and an increased flow of the saliva and of the secretions of the air-passages. It has a pungent taste, excites a sense of warmth in the stomach when swallowed, increases the appetite, and aids digestion. Externally, the fresh root may be used as a counter-irritant and rubefacient, like mustard. By itself the dried root is almost inert, but when combined with mustard it becomes active, and the combination is more efficient than either of the drugs themselves. Internally, it has been employed in *atonic dyspepsia*, *flatulence*, and all forms of *dropsy*, especially those in which there is a lowered condition of the entire system. As a diuretic it is at the present time rarely employed alone, but is occasionally used in combination with other remedies of the same class. A domestic preparation known as "cider mixture" contains ½ oz. each of juniper, mustard seed, and ground ginger, and 1 oz. each of horseradish and parsley roots macerated in a pint of cider. This is quite an efficient diuretic in doses of a wineglassful, and is free from dangerous ingredients; moreover, as a rule, the materials are readily found. An infusion of 1 oz. in a pint of water, to which sugar may be added if desired, will sometimes relieve the *hoarseness* due to a relaxed condition of the mucous membrane of the throat. A warm infusion of the strength mentioned is carminative in half-ounce doses, and in larger quantities somewhat emetic. The dried root is chewed as a popular remedy for *toothache*, and by the mild degree of counter-irritation it produces is doubtless of benefit in some instances. The Br. Ph. orders a compound spirit of armoracia, *spiritus armoraciæ compositus*, of which the dose is from 1 to 2 fl. oz. In cases of atonic dyspepsia its stomachic effects are made use of by its addition to the food as a condiment, and the results are as satisfactory as if the tincture or an infusion were employed.

RUSSELL H. NEVINS.

HUMULUS (U. S. Ph.), *lupulus* (Br. Ph.). —It is extraordinary that a drug possessing so many desirable properties as hops should have been allowed to fall into such neglect. Hops are cheap, easily procured, and entirely safe, and extemporaneous preparations of them are just as useful as those of the pharmacopœias. For internal administration an infusion of half an ounce in a pint of water, although a little bulky, is the best preparation, and may be given in unlimited quantities. The most important property of hops is that of a stomachic tonic in all forms of *dyspepsia*, in which this infusion may be given in doses of from 1 to 2 fl. oz. before meals. Given in the same manner, it is an excellent appetizer, and if its bitter taste is not unpleasant, this infusion, diluted with twice its bulk of water,

quenches the thirst in hot weather and in mild febrile disorders exceedingly well. As the infusion is slightly astringent, mild cases of *diarrhœa* are often cured by 2-drachm doses. In *delirium tremens* it is very useful, having the effect of a stomachic tonic and that of a sedative. It is to be given as freely as the patient can be induced to take it. In these cases tincture of capsicum is a useful adjuvant. Infusion of hops is also of assistance to persons recovering from a *debauch* or attempting to break off drinking spirits or the *opium habit. Irritable bladder, priapism, chordee, involuntary seminal emissions, incontinence of urine*, and all conditions of *sexual erethism*, also every kind of *irritation of the genito-urinary tract*, will be greatly benefited by any of the preparations of hops, but more especially by lupulin, given in doses of from 5 to 10 grains in jelly or syrup. Larger doses of lupulin are apt to cause colic and constipation. *Lupuline* is the alkaloid of hops, and is mentioned here in order that it may not be confounded with lupulin. For the relief of *pain* hops are used very extensively in domestic practice, either as an addition to poultices or by themselves. In the latter case it is customary to have a bag containing them which is dipped into hot water, applied over the painful spot, covered with rubber or oiled silk, and renewed as soon as it becomes cold. Although there seems to be no good reason why this application should be more effectual than the ordinary methods of employing hot water, it undoubtedly is. It is more especially applicable in *toothache* or *earache* in children. A pillow stuffed with hops is frequently used to promote sleep, but beyond the moral effect and an agreeable odour it is not of much service. For this purpose the loose hops are to be preferred to the compressed, as they are more elastic and less liable to be broken. Much of the benefit of properly made malt liquors is from the hops they contain, but at the present time the quantity used in their manufacture is so slight that their effect is not worth considering.

The dose of the infusion, *infusum lupuli* (Br. Ph.), is from 1 to 2 fl. oz.; that of the tincture, *tinctura humuli* (U. S. Ph.), *tinctura lupuli* (Br. Ph.), from ½ to 2 fl. drachms: that of the extract, *extractum lupuli* (Br. Ph.), from 5 to 15 grains. (Cf. LUPULIN.)—RUSSELL H. NEVINS.

HUNYADI JÁNOS is an aperient mineral water originally obtained in Buda-Pest, Hungary, but now more commonly used in an artificial form. The natural water contains about 157 parts in the thousand of sodium sulphate, a similar amount of magnesium sulphate, 11 parts of sodium chloride, 6 of calcium carbonate, a little potassium sulphate and strontium carbonate, with traces of iron and aluminum, and free carbonic-acid gas. It acts as a saline purgative and hydragogue. The dose is from 1 to 8 fl. oz.

An artificial substitute may be made by dissolving in 16 fl. oz. of water 519·54 grains of sodium sulphate, 514·92 of magnesium sulphate, 2·76 of potassium sulphate, and 39·15 of sodium chloride.

The purgative action of Hunyadi János is due to the sulphates of sodium and magnesium which it contains. The former, Glauber's salt, has a more nauseous taste and a harsher and more rapid action than the latter, Epsom salt. The action of either of these sulphates on the mucous membrane of the intestine is to increase the secretion of water into the lumen of the bowel, thus depleting the portal vein and liquefying the fæces. The sulphates which are absorbed stimulate little or no peristalsis, but do excite the intestinal glands. Nearly the whole of these sulphates is returned to the fæces with the secreted water. If much fluid is swallowed, or the salines are largely diluted, as in this mineral water, the volume of the blood is restored with but slight loss of the plasma. As but few of the nutritive constituents of the blood are lost, there is but slight consequent depression and weakness. Hunyadi water is thus used for *indigestion* and for *habitual constipation.*

The cholagogue action of Hunyadi János comprises the direct increase of the bile by the sulphate of sodium, and the reflex evacuative action of the sulphate of magnesium upon the biliary ducts and the gall bladder. The intestinal glands also are stimulated. Hence this mineral water is a valuable remedy for *disordered liver*, for *deficient intestinal action*, and for *diarrhœa.*

The hydragogue action of Hunyadi János relieves *acute congestion* by reducing the general blood-pressure. The bowels are unloaded, and the liver, heart, blood-vessels, and lungs are relieved. It is thus a useful remedy in *chronic congestion of the pelvic organs, liver*, or *intestines.* In *dropsy*, where the fluids of the blood are being forced out of the vessels, these saline hydragogues will deplete the portal system, relieving the systemic veins and the heart. All fluid diet is restricted, so that as much water as possible may be drained from the blood. When this aperient does not purge it will have a diuretic effect, due to the sulphates of potassium and magnesium.

HYÆNANCHIN.—This chemically neutral bitter principle, obtained from the seeds and seed-cases of *Hyænanche globosa*, a buxaceous plant of southern Africa, has been found by Engelhardt (*Arbeit. d. pharmak. Instituts zu Dorpat*, viii; *Dtsch. Med.-Ztg.*, May 21, 1894) to resemble strychnine in its physiological action, but to act more upon the brain and less upon the spinal cord. On this account he thinks it may advantageously be substituted for strychnine in *amblyopia* and *deafness* of central origin. Further accounts of its action and of the doses that may be employed with safety are necessary before its use can be recommended.

HYDRACETIN, *pyrodine*, or *acetylphenylhydrazine*, $C_6H_5.NH—NH(CH_3.CO)$, is a violent poison, capable of causing collapse. It is an energetic *antipyretic*, but too dangerous to be used except with the greatest caution. The doses employed have ranged from ½ to ¾ of a grain, two or three times a day. Externally it has been used in an ointment containing from

5 to 10 per cent. of the drug in the treatment of *psoriasis*, but even this application of it is not free from danger.

HYDRAGOGUES are purgative remedies which cause copious watery evacuations of the bowels without the production, in ordinary doses, of much gastro-enteric irritation. They include some of the saline cathartics and have the action, in overdoses, of some of the drastics. They excite in the intestine a secretion of watery fluid, probably a true *succus entericus*, according to Matthew Hay. This secretion, accumulating in the intestines, causes evacuation, in part by a gentle stimulation due to the distention of the bowel. Simultaneously the hydragogues reduce the absolute amount of water in the blood and have a slight effect in lowering the bodily temperature. The diuretic action of the drugs is a secondary one, withdrawing more water from the blood as long as the diuresis continues. The hydragogues may not alone produce purgation, for the mass of fluid secreted may simply remain in the intestine. For this reason a simple purgative is usually given in connection with a hydragogue cathartic.

The hydragogue cathartics are *magnesium sulphate*, *magnesium citrate*, *sodium sulphate*, *sodium phosphate*, *tartrate of potassium and sodium*, *sodium sulphovinate*, *jalap*, *elaterium*, *hellebore*, *gamboge*, *colocynth*, *croton oil*, *podophyllin*, and *scammony*. Many of these are little used medicinally, and each has its own therapeutic indication. *Magnesium sulphate* has the preference among the salines for the purpose of depletion through the bowels, being more efficacious and of a less disagreeable taste than the other saline cathartics. It is especially useful in *enteritis* or *colitis*, and produces little irritation to the intestine when one considers the free evacuation it causes. The salines are also properly used after purgation by calomel to rid the intestine of superfluous mercury.

Jalap is used, in combination with calomel, to produce copious watery stools. *Colocynth* is not commonly used alone, but in combination with some laxative, when it is desired to secure a movement in obstinate constipation. On account of its drastic action, it is contraindicated in *dropsy*. *Elaterium* is one of the most active of the hydragogues, and is of use in *ascites*, in *anasarca*, and in cases where there is *congestion* of the upper part of the body. *Hellebore* is a powerful drastic purge and is but little used. For the same reason *gamboge* is not much employed, though it has been recommended for *habitual constipation*. *Colocynth* is not so irritating as gamboge; it is given chiefly in combination. *Croton oil* is an exceedingly drastic cathartic. Its main use is in cases in which patients refuse medication, its small dose making it peculiarly adaptable in these instances. *Podophyllin* is praised in *constipation*, alone or in combination with calomel. Its action is slow, and it can not, therefore, be given with more rapidly working cathartics. *Scammony* is an irritating cathartic, but less drastic than hellebore and gamboge. It is always used in combination. For more minute details concerning the individual hydragogues, see the separate articles.

The indications for the use of the hydragogue cathartics are: 1. To induce a fæcal movement. 2. To deplete the system by removing large quantities of water and to assist the renal function. 3. To reduce temperature. For this use the salines only are employed. 4. To reduce the blood-pressure in cases where there is threatened rupture of a blood-vessel or to prevent continued extravasation when one has burst. 5. To prevent straining at stool in cases of hernia, aneurysm, or tumours of the neck.—SAMUEL M. BRICKNER.

HYDRARGYRUM.—See MERCURY.

HYDRASTINE, HYDRASTININE.—See under HYDRASTIS.

HYDRASTIS (U. S. Ph.), *rhizoma hydrastis* (Ger. Ph.), golden seal, is the rhizome and rootlets of *Hydrastis canadensis*, a small perennial herb found in rich, moist woodlands throughout the United States. It abounds most in the northern and western portions. The dried roots of commerce have little odour and a peculiar bitter taste.

Hydrastis contains two principal alkaloids, *hydrastine* and *berberine*, the latter existing in a much larger proportion than the former. A third alkaloid, *xanthopuccine*, is found in golden seal, but only in insignificant amount.

Hydrastine is the characteristic alkaloid of the drug. It crystallizes in four-sided prisms. When pure it is white and, owing to its slight solubility, is nearly or quite tasteless. Its salts are acid and bitter. The pure alkaloid should not be confounded with the so-called hydrastine of the eclectics, commercial hydrastine. The latter is a mixture of hydrastine proper, berberine, and resinous matter in varying proportions.

[*Hydrastinine* is an artificial alkaloid, the hydrochloride, or hydrochlorate, of which, *hydrastininæ hydrochloras* (U. S. Ph.), has been used hypodermically in doses of $\frac{1}{12}$ of a grain. It is uncertain in its action, and should be used with great caution.]

Berberine is not peculiar to hydrastis, but is found also in numerous other plants. It is a yellowish powder, consisting of fine acicular crystals and having a bitter taste.

The preparations of hydrastis are the fluid extract, *extractum hydrastis fluidum* (U. S. Ph., Ger. Ph.), the glycerite, *glyceritum hydrastis* (U. S. Ph.), and the tincture, *tinctura hydrastis* (U. S. Ph.). The dose of each is from 10 minims to $\frac{1}{2}$ a fl. drachm.

Various therapeutic properties have been alleged for hydrastis. It has been employed as a general and as a stomach tonic. It acts as a simple bitter and promotes appetite and digestion. Hydrastis has been regarded as a hepatic stimulant of some efficacy, and it is used as a substitute for alcohol in the treatment of the *alcohol habit*. It is especially useful in diseases of the mucous membranes, and is employed in *chronic gastric catarrh* and in *chronic enteritis*. From 10 to 20 drops of the fluid extract are given before meals. By its effect in

increasing the intestinal secretion it is slightly aperient, and is especially indicated as a laxative when the stools are hard and dry.

In *catarrh of the gall duct*, with jaundice, it is a remedy of some value. In *catarrh of the cystic duct*, leading to inspissation of bile and crystallization of cholesterin, it has been especially recommended. It is employed with good effect in *catarrhal conditions of the vesical* and the *vaginal* and *uterine mucous membranes*. When practicable, its internal and topical use should be combined. A drachm to the pint of water may be used as a vaginal douche. In a case of *membranous dysmenorrhœa* which had resisted other treatment, Jordan reports complete relief by the administration of 25 drops of the fluid extract twice daily, beginning eight days before the menstrual period.

Stomatitis, whether *aphthous* or *mercurial*, generally yields to local applications of the fluid extract in full strength or diluted. Similar treatment has been used with satisfaction in *follicular amygdalitis*, in *pharyngitis*, in *chronic coryza*, and even in *syphilitic affections of the throat* and *nares*. It is a useful application in *fissured nipples*, in *otorrhœa*, in *anal fissures* and *ulcers of the rectum*, and in *hæmorrhage from the lower bowel*. It is employed locally in *indolent sores*, in *old ulcers* of the legs, and in *chancroids*, to stimulate repair and to correct foul secretions.

Hydrastine has been recommended in *paludal cachexia* and in *intermittent fevers*, but for this purpose it is much inferior to quinine. Hydrastine diminishes the quantity of albumin in the urine in *chronic nephritis*. Eliminated chiefly by the kidneys, its action is to some extent diuretic. Good effects are alleged for its internal employment in *spermatorrhœa* and in *gonorrhœa*. An aqueous solution of the impure hydrastine, in the strength of from 3 to 5 grains to the ounce, is used as an injection in the subacute stage of *gonorrhœa*. The injection is repeated twice daily, and the drug may be given internally at the same time. In *granular conjunctivitis*, according to Keyser, 3 grains of pure hydrastine in an ounce of glycerin is a useful application.

In gynæcological practice hydrastine, given internally, is an agent of recognised value as a uterine hæmostatic, both in *puerperal* and in *non-puerperal hæmorrhage*. According to Schatz, its action here is chiefly on the uterine mucous membrane rather than the muscle, exciting vascular contraction. Yet in large doses hydrastine is an ecbolic. It is also reputed to be a direct emmenagogue. Commercial hydrastine, in aqueous solution, 5 grains to the ounce, is used as a douche in *gonorrhœa* and in simple *vaginal leucorrhœa*.

Hydrastine is employed in skin diseases. From 2 to 6 grains of the hydrochloride of hydrastine in an ounce of water is an excellent lotion in *hyperidrosis*. As a stimulant to the sebaceous glands it finds application as a topical remedy in *acne* and in *dry seborrhœa*. An ointment containing from 5 to 30 grains of the hydrochloride of hydrastine to the ounce is useful in *indolent ulcers*, not only as a stimulant to repair, but to destroy fetor. Its antiseptic and deodorizing properties make it of avail in *ulcerating carcinoma* and in *bromidrosis*.

Berberine has some special action on the gastro-intestinal tract, and has been used in doses of from 5 to 10 grains as a simple tonic.

In large doses hydrastine is an active poison. Its first effect is increased reflex activity, with clonic and tonic convulsive movements. The irritability of the muscles and motor nerves is exhausted, and loss of voluntary movement follows. Death may occur during tetanic fixation of the respiratory muscles, or later from respiratory arrest due to paralysis. Berberine is not so powerful a convulsant. Minor effects of hydrastine in smaller toxic doses are digestive derangements and constipation.

Charles Jewett.

HYDRIATICS, *hydriatrics*, or *hydrotherapeutics*, is the science and art of applying water to the human body for the cure or relief of disease, either local or general.

It has been so used from the earliest times, and not only when disease actually exists, but as a means of refreshing and strengthening the body and rendering it less vulnerable to the action of unfavourable conditions and influences. A wider, and perhaps more exact, definition, even from a medical point of view, would be, therefore, the use of water as a means of either preventing or curing disease, diminishing the suffering consequent upon it, or counteracting its deleterious effects upon the organs or tissues of the human body. The latter definition, though longer, is more exact than the first, and more fully expresses all that is meant by *hydrotherapeutics* when used in its widest sense. The first definition, however, more exactly expresses the meaning of *hydriatrics* as used in its modern and restricted medical sense. And it is from this point of view that I shall here treat the subject, avoiding historical and many other points of general interest, in relation, for example, to the use of the bath by the ancients, who employed it mainly as a luxury, and its use in Oriental countries or among semi-civilized peoples at the present day.

When studied from the point of view of physiology and practical therapeutics, hydriatrics assumes an importance second to none among the various agents from which the physician has to choose in the pursuit of his calling. For a correct and thorough understanding of the subject it will be most profitable to consider the application of water *locally* and *generally*, *internally* and *externally*, and to discuss its effects, first, from the *physiological*, and, second, from the *therapeutical* standpoint.

We will consider, first, the *general* effect of water when introduced into the *interior* of the body. And here the dividing line is not distinct because, when taken by the mouth or rectum, it has, necessarily, in addition to its *general* effects, distinct *local* actions upon the viscera with which it comes in contact. It will be more conducive to a proper understanding of the subject, however, to consider these incidental local results of its ingestion

at the same time with the more general influences which it exerts upon the body at large. And this is not to be considered as a deviation from the general rule of treatment by constitutional measures, inasmuch as there is no drug or physical influence that acts conspicuously upon the body generally but has also its peculiar effects upon the local phenomena at the point of its impact on or introduction into the system.

Effects on the Stomach and Intestine.—When *cold* water is taken into the stomach, its primary effects will depend entirely upon the condition of the alimentary canal and the constitutional state of the person who takes it. In the majority of healthy individuals, if not in all, the stomach. in the morning and before taking food, is empty and contracted so as to present the appearance of a tube the inner walls of which are so nearly in contact that its calibre is considerably less than that of the small intestine, excepting when the latter is extremely contracted. This tubular stomach curves obliquely downward and to the right from the cardiac to the pyloric orifice, the fundal cavity being almost entirely obliterated by the contraction of the oblique and circular fibres, the action of which can be readily comprehended by reference to the cuts in any standard work on anatomy.

Under these conditions the water will run directly through into the small intestine, its only effect being, by the sudden chill, to exert some influence on the tone of the blood-vessels and the gastric muscular coats, while washing through whatever mucus or *débris* of food does not cling too firmly to the surface, and transmitting, also, through the gastric nerves to the splanchnic branches of the solar and renal plexuses, as well as, perhaps, by direct conduction, its influence to the surrounding viscera.

The most easily perceived of these collateral effects is that upon the kidneys, for the ingestion of cold water in this way has been shown, experimentally, to produce diuresis, independently of the amount of fluid in the blood-vessels or of the time occupied in absorption.

Besides these results, we may observe an acceleration of the heart beat, increased intra-arterial tension, and greater vigour of the respiratory act. On the intestinal tract it will exert a similar influence, bringing about an increased peristalsis, perhaps increased secretion of the intestinal fluids, and frequently an evacuation of the alvine contents.

If, on the other hand, the stomach is not contracted, as may frequently happen in consequence of incomplete digestion, the presence of gas owing to fermentation of substances which have been taken the previous evening, or of the relaxation resultant from a chronic gastric or gastro-intestinal catarrh, or if it has failed to contract because the nervous system has lost its tone from any cause, the phenomena will be different. The energy derived from the liberation of heat in the stomach will probably be mainly exhausted in securing contraction of that organ and of the blood-vessels in its walls, thus discharging its contents into the duodenum and preparing the stomach for the reception of food. But there will be little or no diuretic or cathartic effect unless the quantity of water is large; and the changes observed in the respiration and circulation will not be so obvious as in the first case noted.

In other cases, where the relaxation is great, both of the muscular walls and of the blood-vessels of the stomach, or of the stomach and intestines—such as may result from excessive eating, overindulgence in stimulants, or great prostration of the nervous system in neurasthenia from overwork, long-continued anxiety, dissipation, and other enervating causes—the morbid conditions may make any normal reaction impossible, or at least delay it until the water which is taken has slowly passed through into the intestine, when another dose may have the desired effect. Or it may happen that the water first introduced may give rise to nausea and vomiting, by which the stomach is relieved of its abnormal contents, the reaction being very salutary.

The effects of *hot* water taken in the morning will also vary according to the prevailing conditions of the alimentary canal and the constitutional state of the subject. In the healthy condition, previously described, in which the stomach is contracted to its tubular shape, the vessels are not unduly relaxed, and the nervous system is so refreshed by rest and sleep that it readily reacts to normal stimulation, the heat may prove to be the reverse of beneficial. If the water is simply warm, it will, in all probability, induce nausea, while if hot, the overstimulation may cause an undue secondary reaction, with relaxation of arterioles, supersecretion of mucus, and perhaps flatulence. This secondary relaxation may prevent the intestinal evacuation which would relieve the distress.

If, however, there is a pathological relaxation, an atony of the muscular and nervous apparatus, with hypersecretion, distention, and, as a rule, flatulence, the hot water may have just the stimulant effect which is needed, and give as good results as cold water, or better. This is more particularly the case when we have to do with such enervated conditions as are found in *chronic alcoholism*, and the results of excess in any direction, mental or bodily. Probably, next to inebriety, prolonged grief and anxiety, especially when combined with loss of sleep, are the most potent causes of this condition. It should be remembered, however, that the constitutional peculiarities of individuals have a most important influence upon these pathological conditions and upon the reactions of the tissues to agents introduced from without.

Constitutionally, the effects of the introduction of cold water into the stomach are manifested in a series of phenomena more or less distinct, the nature of which has already been indicated by what was said in discussing its local action.

I have referred more particularly to the effects observed after the taking of water on an empty stomach in the morning, because they are then most pronounced. But some-

what similar results follow its ingestion at any time of the day. There are, however, certain occasions and conditions of the body and its organs which must be mentioned as important, in that they present peculiar indications or contra-indications for the use of this fluid *per os.*

In the first place, it must be noted that with many individuals, though not by any means with all, the sudden cooling of the stomach and its contents which would follow the taking of a considerable quantity of cold water soon after a meal would act as a check to the secretion of the gastric juice, and so delay digestion. With others, on the contrary—for instance, those who are plethoric or who from any cause have a tendency to super-secretion of gastric juice, or to an excessive acidity of that fluid—the checking of its secretion or its proper dilution will prove a positive aid to digestion. Another interesting observation (for which the writer is indebted to his friend Professor Jonathan S. Prout, the distinguished ophthalmologist) is that, in the case of many persons whose digestion is slow and who, an hour or two after a hearty meal, are oppressed with a feeling of langour and disinclination to exertion, a tumblerful of cold water, apparently by its dilution of the nutrient mass, perhaps by the toning up of relaxed gastric or vascular muscular fibres, or by exciting the reflex action of the splanchnic pluxuses, is a means of speedy and well-marked relief.

On the other hand, in many cases of atonic dyspepsia and of the gastric catarrh secondary to it, which are prone to be accompanied by "water brash," or too great an amount of physiologically inert liquid in the stomach, it is better to abstain from water at or soon after the meals. In such cases water, if of any use, is productive of most benefit if given an hour or half an hour before meals, or on rising in the morning, to flush out the stomach and small intestine and prepare them for the reception of food. These nice discriminations in practice can only be decided by carefully observing the patient and his peculiarities. Their secondary constitutional effects are obvious.

By due attention to such details as this the writer believes it quite possible to practise successfully without the more complicated and time-consuming chemical analyses of the gastric contents so often recommended at the present day. In fact, to trust to such analyses, to the exclusion of the close clinical observation of the natural history and symptoms of diseased conditions, is to lean upon a broken reed. However, in the hands of expert specialists, and in dealing with obscure and obstinate cases of nutritive disturbances, the chemical and mechanical methods are invaluable.

The *constitutional effects* induced indirectly by the drinking of cold (or hot) water are, of course, those associated with improvement of digestion.

The *direct constitutional effects* are observed in a strengthening, and perhaps a slight quickening, of the heart beat, a slight increase in the vascular pressure, increased flow of urine, and, at times, a laxative effect upon the bowels. Together with these more evident results, we may perceive also a certain brightening of the eye and more elastic carriage of the body, which are due to greater activity in the secretions of the glands of the alimentary canal, and freer discharge of their secretions; to the flushing of the excretory organs, particularly the kidneys, carrying off the effete matters; and to a general improvement and acceleration of the metabolic processes throughout the body. The chemical changes which are constantly occurring in every organ and tissue—both constructive, or anabolic, and destructive, or catabolic processes—are facilitated by the frequent and timely addition of clean water, which serves to more completely dissolve and remove waste products while favouring the degree of dilution necessary, the most advantageous chemical action in the building up of tissues, and the liberation of energy.

That the proper use of water is a tonic and restorative measure can not, then, be doubted. And that it is equally useful as an eliminating agent is known to all experienced practitioners.

The use of water by way of its *injection into the rectum* is scarcely less valuable, both for its local and its constitutional effects. *Physiologically*, the introduction of simple cold water into the rectum results in the contraction of that viscus and the expulsion of its contents. It also, either reflexly or, more probably, by its cooling effect on the vesical plexus of nerves, brings about a contraction of the bladder and the discharge of whatever urine or other matters it may contain; while, by reflex action through the sympathetic branches connecting the rectum and bladder with the renal plexus, it does, undoubtedly, have a diuretic effect similar to that which follows its intrusion into the stomach. The vaginal and uterine nerves are at the same time stimulated, so as to cause an increased tonicity in these organs; and the action upon them is often much more salutary when exerted in this manner than when cold is applied directly to the vaginal mucous surface. We get the tonic effect without the shock of the cold, which, particularly in women who are not robust, may be followed by pelvic pain, or even by congestion and inflammation. In this way, while relieving the rectum, cleansing its surface, combating the atony of the hæmorrhoidal vessels, or assisting a weak or partially lacerated sphincter muscle to more nearly perform its function, we may diminish a *vaginal* or *uterine catarrh*, and give increased vigour to the pelvic organs generally. This is a valuable means of treatment for certain selected cases of pelvic disorder, which is too little considered and too seldom made use of by physicians or surgeons, although the latter seem to appreciate it much more than the former.

The *constitutional* results following upon the use of cold water *per rectum* are similar to those observed when it is administered by the mouth, excepting that they are not so pro-

nounced, and are, indeed, scarcely evident as far as the functions of respiration and digestion are concerned. The latter, however, may be somewhat aided by the removal of effete and, at times, foul matters from the lower bowel. The same remarks apply to *hot* as to cold water when it is thrown into the rectum, but *lukewarm* water has scarcely any effect save as a means of removing the rectal contents.

The *therapeutic* uses of water when given internally, either by the mouth or by the rectum, are pretty clearly indicated by what I have already said. I may add, largely by way of recapitulation, that water is a useful medicament in: 1. *Functional disorders of the stomach* and *intestines*, especially in *chronic*, *gastric*, or *gastro-intestinal catarrh*, in atony of the muscular walls, mucous coat, or nervous mechanism of this canal. That when the stomach is contracted to its tubular form the fluid ingested may run immediately through into the small intestine is frequently demonstrated when the siphon-tube is used, as large quantities of water poured in through the tube are sometimes not recovered by its siphon action, nor is the typical distention visible externally. The water simply passes on into the small intestine, washing the mucous membrane as it goes. And this washing is much more complete if the water contains some alkaline sodium salt in solution. 2. In the treatment of some cases of *constipation*, its value here being greatly enhanced by the presence of sodium salts in solution, sodium phosphate being the mildest of those whose laxative action is to any extent reliable, and this acts better, in some instances, if its alkalinity is assured by the addition to it of a moderate quantity of sodium bicarbonate. 3. In *flatulent conditions* or *catarrhal irritability*, causing *irregularity of the cardiac rhythm* or *palpitation*. 4. In *lithæmia*, accompanied by acid, high-coloured urine. The flushing of both the alimentary and urinary tracts, the latter increased by the positive diuretic effects of the introduction of water into the stomach, irrespective of its increasing the amount of the circulating fluid in the blood-vessels, does, actually, as it is popularly expressed, purify the blood. This, together with the salutary influence on the digestive operations, will easily account for its good effects. Here cold water is usually the best, though this must be left to the judgment of the person who is treating the case. 5. The value of water in cases of more serious disease of the stomach—such as *ulcer, cancer, constriction of the pylorus*, with secondary *dilatation*—is, in skilful hands, very great. In fact, in some of these cases it is by far the most valuable agent we have. But its use by the tube is to be entered upon with great caution and proceeded with carefully, all effects being noted. *The cases in which artificial irrigation of the stomach can safely be left to a nurse are few if organic disease exists*, and specially trained nurses should be reserved for this work; but in the simpler forms—*i. e.*, functional disorders—the attendants can easily be trained to carry out the directions, which should always be very explicit. 6. In *febrile* and *inflammatory states* the drinking of cold water serves a threefold purpose—viz., to favour the action of the emunctories, removing effete matters from the body; to assist digestion, when judiciously employed; and to allay the burning and sometimes tormenting thirst which is a source of so much suffering to many sick people. The water used for this purpose should be as pure as it is possible to procure it, cold enough to be palatable, and given in small quantities at short intervals. The latter caution should always be observed if there is any tendency to pulmonary congestion, as in congestive and inflammatory conditions of the thoracic viscera, or any incompetency of the heart. When these conditions prevail, the sudden introduction of a large quantity of cold water into the stomach may cause a contraction of the abdominal vessels and an accumulation of blood in the thorax, which may even be fatal. 7. To induce or favour diaphoresis. For this purpose it is used in connection with the different varieties of the wet pack, and also to assist the action of diaphoretic remedies. The water should be hot, and, if unpalatable, may be administered in the form of an infusion of tea, of hot lemonade, etc., its diaphoretic properties being still further augmented at times by the addition of some alcoholic stimulant.

As a *rectal* application, water has also many and valuable therapeutic properties. Besides those already alluded to in the discussion of its physiological actions, it is often, and very successfully, used in the treatment of such local diseases as *acute* and *chronic dysentery, chronic hæmorrhoidal conditions*, with or without *fissures*, and *fæcal impaction*, and to cleanse and purify the rectum and its contents in *fistulæ in ano*. In prolapsus, as was hinted at above, it may, by facilitating the removal of the fæcal mass and so preventing the dangerous act of straining, as well as by virtue of its tonic effect upon the intestinal muscular coat, be a most useful adjunct to other forms of treatment, and may even, in recent and not too severe cases, be sufficient of itself to cure the condition.

In ulcerated conditions and in fistula, hot water, holding in solution some mild astringent and antiseptic or disinfectant, should be used. Good results may be obtained from a 1-per-cent. solution of carbolic acid, from the same proportion of zinc sulphate, or a weak solution of the chloride of iron. But by far the most valuable agent for this purpose is the nitrate of silver in a strength of one quarter of one per cent. Previous to the injection of these medicaments the bowel should be thoroughly cleansed by enemata of water as warm as can be comfortably borne. The nitrate of silver is especially efficacious in fissured or fistulous conditions, partly on account of its astringent and healing action, but largely because of its extraordinary power as a disinfectant.

In *fevers* also, rectal enemata are of great value. They help to remove foul and, at times, undoubtedly, pyrogenous substances from the intestine; when cold and copious in

quantity they have some antipyretic effect; and in the troublesome and often dangerous *meteorism* of fevers of the typhoid type their excitation of the reflexes of the mesenteric and solar plexuses, inducing more decided peristalsis of the intestine, with a tonic influence upon its vaso-motor apparatus, may be the means of saving life. This is one of the most important details in the treatment of bad cases of enteric fever.

In uterine hæmorrhage, again—*i. e., post-partum hæmorrhage*—the injection of iced water into the rectum, in connection with the use of ice externally and *per vaginam*, is a powerful means of promoting the uterine contraction. And after perineal ruptures, when the rectal control is partially lost and the ordinary surgical procedures have failed to bring relief, daily enemata of cold water, or of a cold solution of nitrate of silver, may give considerable relief by increasing the tone of such muscular fibres as remain uninjured, and perhaps, too, by their favourable influence on the general health.

Finally, I may mention the use of rectal injections in the removal of *parasites from the lower bowel.*

The uses of the water treatment in the *pelvic diseases of women* are many and of undoubted efficiency. In fact, there is no agent which has borne the test of time and experience more successfully than this. It is applied both internally and externally. Internally it is applied in the form of the *vaginal douche*, or at times simply to the inner or mucous surface of the external genitalia, very little penetrating beyond the vestibule excepting when there is considerable relaxation, in women in whose pelves there is no deposit of fat, and when a favourable position is assumed, such as the knee-elbow, or with the pelvis considerably raised above the level of the shoulders and chest while the patient remains in the dorsal decubitus. For home practice the latter position is the most practicable, but in case of any gonorrhœal or other contagious malady it is not advised, as there is some danger—very slight, to be sure—of its favouring the penetration of disease germs into the uterine cavity. Again, where there is marked *prolapsus* or *procidentia uteri*, so that the portio vaginalis of the uterus presents at the vulval orifice, or even protrudes beyond it, while advantage may be taken of the dislocation of the organs to thoroughly cleanse the entire external genital tract, special pains should be taken that no risk is run of infecting the mucous membrane of the uterine canal.

For the washing of the mucous surfaces, either of the external genitals as far back as the sphincter vaginæ—which is all that can usually be done—or for the more extensive cleansing which may be rendered possible by prolapsus with great relaxation or laceration of the sphincter and levator muscles, hot water with borax is one of the best solutions. It is, however, rendered more efficacious by the addition of pure carbolic acid, so as to make a one-half or one-per-cent. solution. The carbolic acid should be mixed with an equal part of pure glycerin to favour its solution. Of this mixture, a teaspoonful, or two at the most, to a pint of water will give about the right proportion. Instead of borax, phosphate of sodium and bicarbonate of sodium, rubbed together, a heaping teaspoonful to the pint, may be used, and, in my estimation, this solution is preferable to that of borax for cleansing purposes. It is of special advantage in *infantile leucorrhœa*, in the treatment of which I regard proper *washing* as better than *douching.* And the same may be said in regard to the leucorrhœa of many young girls and unmarried women in whom the catarrhal condition does not extend to the cervix, and with whom the mere external cleansing is all that is needed, in many instances, in connection with general tonic measures, to overcome the difficulty. Besides, it is felt by most practitioners, I presume, that the minimum amount of treatment is advisable for such subjects on moral grounds. The addition of carbolic acid, too, owing to its superficial anæsthetic effect, has its moral as well as its therapeutical advantages—an instance of the close relationship between cleanliness and godliness. When the above-mentioned materials are not at hand a good pure toilet soap, or the *genuine* Castile soap, answers well. In any case, where simple washing of the genitalia is practised it will be found advantageous to follow it by a free sponging with *cold* water.

But when it is necessary to treat a more deeply-seated trouble the *hot douche* is strongly recommended by those who have experience with this class of diseases. Not only is it used as a means of cleansing the parts—which is, to be sure, very essential—but it has, beyond doubt, a curative effect on *catarrh of the vaginal and cervical mucous membrane;* on conditions of *relaxation and passive hyperæmia; subinvolution of either uterus or vagina*, or both; and on *congestive, swollen*, and *neuralgic conditions of the ovaries, tubes, and adjacent tissues.* It may also, indirectly, as a rule, alleviate the tendency to *frequent* and *painful micturition* which is sometimes associated with the above-mentioned disorders. I speak particularly of the hot douche in this connection because it is the safest and most generally employed; but there are cases in full-blooded, relaxed, but naturally robust women in which the cold douche is of the greatest service. It is, however, a nice point, and must be left to the decision of the individual practitioner.

The method of employing the douche is simple, and it may be carried out either with a fountain or bulb syringe, the main point being to secure a steady, uninterrupted flow of water, with the entire exclusion of air. If hot water is used, as is generally the case, the temperature should be as high as the patient can conveniently bear, the quantity large, say from two to three quarts, and the flow so slow that at least ten minutes are consumed in its passage. It is, by some most excellent authorities, recommended that during the operation the patient should be in the recumbent posture; but we do not feel justified in giving this as a

general rule, as it has often happened, to our knowledge, that after the use of the douche in this way the patient has been seized with violent spasmodic pains (or cramps) in the lower abdominal and pelvic region, caused, in all probability, by penetration of fluid into the cavity of the body of the uterus. The most comfortable method is for the patient to sit on a commode of convenient height, the bag of the fountain syringe not higher than the level of her chin, or the vessel of water for the bulb syringe on a stool in front of her, the feet on a low stool, and the body bent forward so as to relax the muscles of the abdomen and perinæum. If a bulb syringe is used, it should first be squeezed a few times to expel all the air; and in the use of the fountain syringe care should be taken that the air is all out of the tube and the water flowing freely before the nozzle is introduced. The latter should be large enough to pass easily without catching on the folds of the mucous membrane, long enough to reach into the posterior fornix vaginæ (*i. e.*, into the arched space behind the cervix), and of hard rubber rather than of metal, as the former is not so good a conductor of heat as the latter.

In ordinary cases of no great severity hot water alone is usually sufficient; but when the leucorrhœal discharge is more *purulent* in character such a solution as that recommended above is of more value; and it is better to irrigate first and use the solution afterward than to employ a large quantity of a weak solution. Other agents of great service are sulphate of zinc (20 grains to a pint of water) and cresol (a drachm to a pint of water). There are many astringent and antiseptic agents besides those mentioned, for which the reader is referred to the articles on gynæcological subjects. For directions as to the use of vaginal douches in *cancer of the uterus* or *vagina*, and for the introduction of water into the cavities of the nose, ear, and throat, reference must also be made to the particular articles which deal with the diseases of those organs. I will, however, refer briefly to the benefit to be derived from carefully washing out the pleural cavity after operations for empyema, for it is not always safe in such cases to impregnate the water with the various substances which many consider almost indispensable as means of preventing decomposition of pus, checking its formation, or procuring a more rapid closing of the cavity. An exceptionally large and varied experience has taught the writer that after the first evacuation and washing out of the pleural cavity for empyema, even when the pus is quite foul, in the majority of cases healing will take place if the pleura is well drained, without any further irrigation. And when the pus retains its offensive odour, simple warm, sterilized water is almost always sufficient, if used freely and associated with liberal drainage, to overcome the fetor. It may not be out of place to say that too complicated an apparatus for drainage, unless in very skilful hands, may be the cause of the fœtid odour from these and other cavities; and that the greatest need is for a very free opening, so that the pus may quickly escape into some antiseptic dressing. This is far better and safer than any amount of irrigation.

Externally, the application of water is also resorted to, both for its *local* and for its *general* effects. It is used in the form of douches, baths, showers, sprays, etc.—that is to say, by itself, without the intervention of any secondary means of retaining it upon the surface; and by the aid of the wet sheet, towels, fomenting appliances, etc., to prolong the contact, influence the temperature, secure the effects of prolonged moistening or soaking of the tissues so as to relax, soften, and, as it were, partially "parboil" the superficial structures locally, increasing mobility, and permitting of freer manipulation than would be possible without some such preliminary measures. By the external contact of water of different temperatures for varying lengths of time, and to either the whole or to certain parts of the cutaneous surface, general or constitutional effects may be obtained and certain therapeutic objects accomplished in relation to the viscera, which, though primarily local, are accompanied by and productive of collateral constitutional results of the utmost value. I will consider first the more extensive manipulations of the *bath* and *pack*.

The Cold Bath.—This may be divided into the *cold plunge*, *shower*, *douche* or *affusion*, sitz-bath, and sponging. These varieties of the cold bath have their own individual effects, both local and general, and their particular therapeutic applications. They are among the most important therapeutic means at our disposal, especially in certain *acute febrile and inflammatory diseases*, as well as in many chronic affections. To neglect them is to overlook, perhaps, the most valuable means of cure in some of the derangements which are constantly presenting themselves for aid to both the general practitioner and to the specialist.

The *cold plunge* is a measure of treatment which is of importance in the treatment of chronic ailments such as the following: 1. In *constitutional debility*, where it is important to invigorate the body generally, although, of course, the shock involved precludes its use in cases where the debility is too well marked. It finds its greatest utility in the case of one who is naturally robust but who has become weakened by overwork, "carking care," or any of the numerous strains incident to the battle of life—strains which have an apparent tendency to accumulate and combine their assaults on the organism which is the unfortunate victim of them. But for those who inherit what is termed a "delicate constitution" this form of bath is to be worked up to with great caution, the subject being led through a gradual system of training to the point of resistance necessary to obtain the benefits resulting from the reaction after sudden immersion in cold water. As its name indicates, the water used for this bath is *cold*—*i. e.*, its temperature is so low that it produces on contact a decided sensation of cold. The actual temperature may be anywhere from the freezing point to 65° F., usually between 50° and 60° F. There must be sufficient water to cover the patient's

entire body, and he should enter quickly. If the bath is large enough and the patient strong enough, he should make an actual plunge into it, submerging the entire body at once, including the head. If this is not practicable or advisable, the person should at least rapidly submerge the entire body, and either he or an attendant should continue to lave and rub the head, nucha, and the rest of the body. After not longer than one minute he should step out on to a warm towel or rug, the body be actively rubbed with the hands or a coarse bath cloth or brush for two or three minutes, after which, if the reaction seems good, the plunge is repeated. If the room is not warm, or if the plunge is taken in the open air and there is any wind, it is better not to repeat it. When the final emergence is made, a large bath towel should be thrown over the patient, head and all, and he should be vigorously rubbed and dried. After the skin is dry it should be well rubbed with the dry hands, using more or less slapping, until the skin is of a good colour and warm. When first introducing one to the use of this bath it is well, as soon as the torso is dry, to draw on the undershirt, and attend to the legs and feet afterward. The entire proceeding should be conducted as speedily as possible. There are two general auxiliary directions of great importance. In the first place, no one should enter a cold plunge-bath except he is himself warm, and where there is sufficient bodily vigour (as there must be in most cases, to justify the use of such a bath) the warmth should be generated by some physical exercise. If the body is perspiring, it should be rubbed dry before the plunge is made. Second, after such a bath the subject should be put in a warm gown, or covered sufficiently with blankets to keep him warm, and made to rest for at least half an hour. As for *special* points of guidance in the use of the cold plunge, it may be said that women may use it excepting during and for two or three days before the menstrual period. A day should also be allowed after menstruation has apparently ceased for the subsidence of the physiological congestion accompanying this periodical phenomenon. Again, it is undoubtedly true that only the most robust can use this form of the bath on rising and before breakfast, as the power of reaction is at its diurnal minimum at this time, and the majority, even of fairly healthy people, will experience only languor and depression from such free use of cold water before the vital functions have been brought up to or near the acme of their energy by the exercises of the first half of the day.

Yet the cold bath—by which term, when used generically, we mean the utilization of those effects of cold water upon the body which can be obtained by its application to the surface—is one of the most useful of our therapeutic resources.

In common with all the means by which the physical forces *per se* are made to act upon the animal organism, it can not fail to produce a tangible effect. Its simplicity as regards the forces involved makes it possible to estimate with considerable accuracy the phenomena resulting from its application.

The *dose*, if we may apply that term to indicate the totality of efficient factors brought into operation by one application of water to the surface or otherwise, is capable of being stated or recorded with a near enough approach to accuracy for all practical purposes.

The factors which are to be taken into account as contributing to the total effect, or in making up the dose, are: 1. The temperature of the water; this may be constant or graduated—*i. e.*, increasing or diminishing. 2. The need of contact. 3. The mode of application—*e. g.*, simple laying on (the pack); affusion, or pouring on; the shower; immersion, etc. 4. The duration; the application. 5. The physical conditions of the surrounding atmosphere—*i. e.*, temperature, barometric pressure, humidity, and the presence or absence of aërial currents.

Another special point, and a very important one, is that in cases of long standing, as, for instance, the nervous exhaustion from overwork and excessive strain which we see in business and professional men who have for years, in addition to their great responsibilities, been uninterruptedly engaged in the performance of those duties which require physical activity, and with whom, necessarily, it is essential that the therapeutic measures adopted should, at the outset, be most carefully regulated not only to insure success, but also to be certain of the effect of our remedial measures; in such cases the doctor should himself be present to supervise the operation and satisfy himself as to the immediate result. It is not safe to trust any one except a physician to judiciously employ and correctly determine the effects of such a powerful therapeutic agent as the cold bath at the beginning of the treatment. When the physician has satisfied himself in regard to these points, the further use of the bath may be safely intrusted to a nurse or assistant of whose reliability he is convinced. Without this precaution, in private practice, the cold bath is dangerous.

The action of the cold bath is twofold—local and constitutional. *Locally*, its action is very distinct and very powerful. The skin, as is well known, contains in its structure the enormously expanded terminations of the peripheral sensory nerves, an expansion so vast that when we consider the number of nerve-axes—cylinders which, by division into their terminal fibrillæ, conduct the surface impressions to the cerebro-spinal centres—it seems impossible that the nerve-trunks can contain them. And their relations to the ganglionic centres which control the functions of respiration, circulation, voluntary and involuntary muscular contraction, glandular action, the specific tissue changes of growth and nutrition (the trophic function), and even of the conscious and unconscious processes of memory, emotion, and ratiocination, it is evident that such a strong impression as is suddenly made on this entire expansion by the cold bath must have a profound effect upon the organism. It is also evident that it is the duty of the physician to

determine by his own observation whether that effect is a salutary one or not.

If not beneficial, it will certainly be injurious. These effects are, of course, constitutional, but, being inevitably associated with those produced upon the skin itself, must be mentioned here. At the first contact all the contractile elements of the skin contract. The involuntary muscular fibres—which are numerous and so disposed as to make traction vertically, horizontally, and obliquely, in fact, in all directions—produce by their contraction a diminution in the size of the cutaneous covering of the body comparable to that which occurs in an India-rubber envelope which, after stretching, shrinks down upon what it incloses. There is a perceptible tightening of the skin, which at the same time becomes thicker, harder, and rougher on its surface. The roughening is due to the contraction of those muscle-fibres which are attached to the roots of the hairs, and does not occur on those portions of the skin which have no hairs, as the forehead, palms, and soles.

This goose-skin appearance is familiar to every one, and we need only say of it that it is apparently due to contraction of the muscles of the skin generally, and made prominent at these little points by the erection of the hairs and to the obstacle which their roots oppose to depression of the surface.

The contraction of the cutaneous blood-vessels causes a distinct *anæmia*, manifested by more or less pallor, and in localities where the skin is thin and has not much if any adipose tissue there is also a light purplish or violet hue, caused by the emptying of the arterioles while the blood in the venules and capillaries, not propelled by the usual accumulating mass behind it, becomes decidedly venous in character. This spasmodic contraction of the arterial system appears to be pretty general throughout the body. The more highly developed striped muscular bundles of the scrotum, penis, and labium majus, by their sharp contraction, wrinkle the skin and diminish the size of these organs, while the vascular spasm gives them an anæmic and cyanotic appearance. The muscular ring inclosing the nipple lessens, by it own diminution, the size of the areola and erects and hardens the mamilla itself. The subcutaneous muscular strata corresponding to the *panniculus carnosus* of the horse and other quadrupeds—viz., the platysma myoides and the orbicular and other facial muscles—tighten the skin of the face and neck and give to the physiognomy a pinched and "drawn" appearance. In the present state of physiological science it is not possible to state the full significance of the arrest of perspiration as considered apart from the other results of the application of cold water to the body.

Some deductions, however, may safely be made by a careful study of the established relations between the skin and other parts of the body. For instance, the inference is justifiable, provisionally at least, that the known relationship between the functions of the skin and the kidneys (as well as the other excretory glandular organs) is applicable here as well as under other circumstances.

There is also evidence of this in the observations of various clinical workers in so far as the urine is concerned, it having been shown that one of the constant effects of the cold bath is an increase of the urinary output, both fluid and solid; and the normal relationship of alternation between the two functions makes reasonably sure the inference that the increased secretion of urine which follows the cold bath is due directly to the arrest of function in the sudoriparous glands.

There is another observation which the admission of the foregoing compels us to accept as a part of our analysis, but which opposes rather than favours the adoption of the cold bath as a therapeutic agent—viz., that the suppression of the perspiration is followed in many instances by inflammatory disease of the kidneys, as well as of other viscera, either abdominal or thoracic.

That the reduction of temperature would reduce the sensibility of the nerves at the surface is a conclusion which, in the absence of opposing influences, must occur, for the general rule of effect of cold on nervous tissues has, I believe, no demonstrated exception. And the qualitative changes, though they have not been so thoroughly investigated as the others, are important from a physiological point of view, and, as indicating the intensity of the effects, are reliable guides to the determination of practical questions. This statement, though at first sight it may appear to be vague or not of special significance, is really an important one.

The diagnosis in a given case, it may be observed, is not consummated when the disease is properly classified. There remain at least two important problems for solution. The first is, What are the special disturbances of function? the second, What effects upon these disturbed actions can be produced by the measures at our command?

So in the use of cold baths, after having satisfied ourselves as to the character of the conditions which we have to treat, we must estimate the effects of our remedy as nearly as possible before the beginning of the treatment, and be able also to determine the extent to which it is influencing the actions and reactions of the body during the period of its use.

These qualitative changes in the action of the sensory nerves are numbness, or a diminished transmission of the sensations generated by contact with the external world, and comprise partial anæsthesia, analgesia, thermal sensation, and the pressure sense. The degree to which these senses are attended is a good index of the extent to which the bath is influencing the other functions of the body.

Another local effect which, though not a normal or a frequent one, is deserving of mention is pain. I allude to it in order to warn the practitioner against too hastily passing an adverse judgment on the measure, because it happens that, in perhaps the first case in which it is applied, neuralgic pain occurs, and is usually located in the area of distribution of one

of those nerves which are most frequently affected in this way—viz., the fifth cranial, the intercostal, and the sciatic. The lumbar region is not an uncommon site of this pain, which develops suddenly, is occasionally quite severe, and may, unless proper measures are adopted, be of long duration. Although I have not met with an instance of it, or known of its having been reported, it is not impossible, judging from certain analogies, that a cold bath may, in some cases in which the conditions were already such as to constitute a very strong predisposition, have been the immediate cause, as Aristotle would have called it—the determining or precipitating factor—in the production of a chronic neuralgia.

While we must admit the possibility of such an event, the chance of its occurrence as determined by the calculus of probabilities is so small that it may be ignored. There is in many cases a diffuse, dull sensation of pain and pressure in the cranial region, not limited by the boundaries of the area supplied by any one nerve or of a particular set of nerves, but appreciated by the subject as a discomfort which invades the entire mass of the head, exclusive of that part of the face which is below the level of the brow. It is most frequently observed—or has been by the writer—in persons who plunge headforemost into cold water, though it may and does follow upon the taking of a cold plunge in any way.

I am not able to give an explanation of it that is satisfactory to myself; but it may be safely assumed provisionally that it is caused by vascular spasm excited by the shock of the sudden change of temperature and the impact (in diving), this spasm producing anæmia of the cutaneous nerves of the scalp, and perhaps of the dura mater. It is now well known that while the nervous encephalon is not sensitive to pain, the dura is supplied with nerve filaments from the trigeminus, irritation of which may give rise to most intense pain.

This headache, however, which is felt after the cold plunge, does not, as a rule, last more than a few moments—rarely half an hour—and is not repeated after the first two or three baths. Should it be severe, accompanied by dizziness, endure for more than an hour at the most, or continue to recur with undiminished intensity after three or four baths, it would be evidence that the treatment was not properly adapted to the case, and that some modification of the method was necessary.

The *constitutional effects* of the cold bath are numerous, and of such importance as to make it, as has already been seen, one of our most powerful therapeutic resources. These effects are observed in connection with every system, almost with every organ of the body.

The initial influence is upon the nervous system; and if we start with this, we may from it trace the other results with accuracy, and in a logical order so close that they might pretty safely be predicted on *a priori* grounds.

For instance, during the summers of 1893 and 1894, but more especially the latter, while spending my vacation among the hills of Vermont, I was accustomed to bathe every day in a deep pool in a brook. In the bottom of the pool were three or four large springs, which continually poured out water the temperature of which was not above forty-five or fifty degrees. I always entered the water, which on the surface was warmed to a comfortable degree by the radiant heat of the sun, by diving from the bank. Being thoroughly warmed by a walk of about a mile under the summer sun, I would rub the skin dry and plunge in at once before the slightest sensation of chilliness appeared, swim around the pool—a distance of perhaps a hundred feet—repeat the operation, once at first, twice after a week or two, dress, and go home. I have always noticed that for a week or thereabout there would be a dull pain, difficult to localize, but apparently involving the entire cranial portion of the head. This has not at any time, I think, lasted for more than a half hour, often less, and after a few days it would not endure for more than fifteen or twenty minutes.

Within a week it would cease to recur, and no further manifestations of the kind would be noticed. This symptom has been observed in many cases and by numerous physicians. Unfortunately, there have not, so far as I am aware, been any experiments conducted of a sufficiently scientific character to determine the exact cause of this phenomenon. We can not, of course, accept the bold assertions of the pseudo-physiologists who mislead the public by their dogmatic assertions of physiological facts evolved from the recesses of their own inner consciousness.

As this evanescent cephalalgia is observed in those who simply take the cold bath without the headlong plunge, it may be due to spasm of the peripheral vessels and a consequent collateral hyperæmia of the encephalic structures. The superficial anæmia is distinctly observable in the pallor of the face, shrinking of the nose, retraction of the eyeballs with blueness of the infra-orbital region, and occasionally the occurrence of that peculiar spasm of the arterioles of the fingers which gives rise to the appearance known as *digiti mortui*, the last one or two phalanges of one or more fingers assuming the waxy look of death, with numbness and more or less anæsthesia. This is the same appearance that is observed in the fingers of some hysterical subjects, and in the vasomotor spasm of Reynaud's disease.

It may also occur, particularly if the cold bath is entered at a time when the circulation is inactive—*e. g.*, if the body is allowed to become chilled before the bath is taken—that "*cramps*," or tetanic contractions of the voluntary muscles, are produced. The pathology of these "cramps" has not been fully elucidated, but they are presumably due to local congestions of the spinal cord. It is also thought by some* that in many instances where persons are swimming—even if they are experts in that beautiful art—suddenly sink and drown, the immediate cause of death is *angina*

* For instance, Professor George W. Balfour, *Lectures on Diseases of the Heart and Aorta*, Philadelphia, 1876.

pectoris, a disease whose nature I can not discuss here but which is eminently spasmodic in its nature, and is almost certainly a spasm either of the heart or of the arterioles, probably of the medulla oblongata—the vital knot.

These brief statements in regard to the indirect action of cold water on the central nervous system through the medium of the cutaneous nervous expansion, in addition to their special value in descriptive physiology, will also serve to emphasize the idea of the therapeutic power which we may avail ourselves of in the application of hydrotherapy as a part of our resources in the treatment of disease.

It will serve the still more important purpose of impressing upon those of us who have as yet but little experience in this department the need of caution in the introduction of hydriatrics into our armamentarium. And, again, if we accept the view that any agent which is capable of so profoundly affecting the body must be equally potent for good or evil when rightly employed, we have in these few facts enough to encourage us to investigate its action thoroughly in the hope of developing a plan of procedure which will enable us to avoid risk, and at the same time to obtain beneficial results in our treatment.

I mention this here—somewhat out of its proper place—because of the excellent opportunity it affords of drawing attention to these exceedingly important points.

The *therapeutic uses* of the plunge or immersion are as follows:

First, its main use is as an invigorating agent, principally, perhaps, on the nervous system, but also and very distinctly on the muscular tonus and the nutrition of the skin and glandular apparatus.

The *tone* of muscular fibres is that quality by virtue of which they remain, even when at rest, in a firm state suggestive of partial contraction, but really in a state of molecular equilibrium, due, undoubtedly, to their chemical composition. It is a condition called by the biologists unstable equilibrium—*i. e.*, their molecular structure is such as to favour the most rapid assumption possible of the state of contraction on the one hand and of complete relaxation on the other. Through the reflexes of the nerves of the cerebro-spinal and splanchnic systems the voluntary and visceral muscles are affected in a manner similar to that in which the cutaneous and other superficial fibres are influenced. The effects upon the glands are in the direction of a re-establishment of their normal activities, if these have been disturbed, and may be said to be entirely analogous to the restoration of tone to the muscles. The specific glandular cells are, probably through the influence of the nervous system, restored to that normal state of unstable equilibrium (which means simply a delicate balancing which favours prompt movement or change) which is a necessary condition of all healthy vital phenomena.

The same may be said of the viscera, and in fact of all parts of the body, which may be very properly regarded as one immense congeries of glands.

In the year 1802 Gottfried R. Treviranus, of Bremen, published at Göttingen a work on biology which has, in America at least, received as little attention as the work of the greatest of anatomists, Henle, on rational pathology. In this work is formulated, for the first time, so far as I know, the idea that every anatomical element of the body stands, in relation to all the others, as an excretory gland.

This concept was introduced to the English mind by Sir James Paget in his classical work on *Surgical Pathology*, to the French by Milne-Edwards, and has gradually, through the thoughtful criticism of some of our brightest medical authors, been admitted to the list of fundamental physiological truths.

It will be useful to bear it in mind in studying the effects of water on the human organism.

Second, the cold douche or immersion so influences the vascular system as to cause an increase in the arterial tension; with, of course, a higher internal pressure on the walls of the cardiac ventricles, and changes in the intracranial distribution of blood and cerebrospinal subarachnoid fluid.

The cranial cavity is of a size and shape practically unchangeable. During the inspiratory act, when the thoracic cavity is enlarged by from 150 to 350 cubic inches, the suction resulting draws not only air, but blood into the newly-created space.

The outflow of venous blood from the cranium through the jugulars is not compensated by the arterial supply, as the current in the carotids must necessarily be somewhat retarded during two out of every four heartbeats (there being four pulsations to every respiratory act).

The consequence is that the amount of blood in the cranial cavity is diminished, and, as there is nothing else to take its place, the cerebrospinal fluid ascends into the cranial cavity.

The adjustment of pressure in the spinal canal is caused by a phenomenon nearly the reverse of the foregoing. The spinal veins empty into the greater azygos to a great extent, and the increased abdominal pressure during inspiration impedes the discharge of their blood and retains it in the spinal canal so that it takes the place of the cerebro-spinal fluid, and preserves the balance of pressure in the important cavities.

This mechanism, intensified as it is by the deep inspiration which is caused by the sudden contact with cold water, helps us to explain many of the phenomena observed in connection with the cold bath. We are so accustomed to connecting the expansion of the chest with the inspiration of air that we sometimes fail to give due weight to the fact that a certain portion of the additional space can not be filled in this way, but must be occupied by blood.

[The late Dr. Westbrook had prepared the foregoing portion of this article when he was seized with his last illness. The remainder has been furnished by Dr. Brickner.]

The Cold Plunge or Tub Bath.—The first great therapeutic indication for the cold bath or plunge is the reduction of high tempera-

tures due to acute causes, such as *insolation.* It is not only for thermolytic purposes that the cold plunge is of value in these emergencies, but it has been proved so conclusively that it acts as a cardiac and respiratory stimulant, and as a tonic to the central nervous system through its cutaneous endings, that a physiological discussion of its use is scarcely needed here. It is essential that the least possible irritation or disturbance shall come to the patient when he is suffering from an acute disease or affection of asthenic tendency. It has therefore been deemed wisest in such cases to bring the tub or plunge to the edge of the patient's bed. If the patient fears the effect of sudden immersion in cold water, or resists its use, a few encouraging words from the physician will usually dispel his repugnance. It is well to exclude near relatives or friends from the room at the time the bath is given to remove unfavourable psychic influences. For *acute hyperpyrexia* the bath may vary in its temperature from 45° to 60° F. The room should be moderately warm and free from draught. The patient should be lifted by two attendants from the bed and immersed directly and fully up to his neck in the tub. Under no conditions should the patient assist in these manœuvres. Immediately upon his entrance into the cold water a mild friction should be exerted by the hands or with a rough towel on all parts of the body. At the same time a cold compress may be placed about the head, and at intervals cold water should be poured over it. The friction or rubbing must be continued as long as the patient is in the bath. The time limit varies with individuals, but adults can usually be kept in the tub from ten to twenty minutes, children from five to ten minutes. The attendants must be careful to see that the water covers the shoulders of the patient in order that apical congestion may not supervene. During the bath the head may rest against a pillow or cushion. It will not be necessary to remove a patient from the bath because of his complaint of chilliness. It will only then be necessary when the appearance of a true rigour or chill becomes manifest, as evidenced, for instance, by the chattering of the teeth. Cyanosis of the face may be regarded as an indication for removal from the bath, although "blueness" with *cutis anserina* of the rest of the body may be due entirely to the action of the cold water on the superficial blood-vessels. On being removed from the bath, the patient is again laid gently on the bed on which a blanket and dry, warm sheets have been placed for his reception. Hot-water bottles are placed at the feet to prevent shock. The patient is, after a few minutes' rest, gently dried with rough towels.

For the *acute infectious diseases* the method of the bath is the same, except that its temperature varies from 80° to 65° F. Brand immerses the patient at once in a bath of the desired temperature, while von Ziemssen's method is to start with the water at 90° F., and by the addition of water at 40° F., or of ice, gradually to lower its heat while the patient is in the bath. There seems to be little difference in the results of these two procedures, except that the adherents of Ernst Brand's method maintain that the exchange of heat between the body and the water is fostered by the sudden immersion.

The immediate results of the cold bath on *temperature* are a slight rise, due probably to the large amount of heated blood driven from the periphery into the internal organs, or due to the fact that at first an increased metabolism takes place. The temperature of the body in the course of an hour slowly falls. In part this is effected by the active dilatation of the blood-vessels of the skin following their early contraction (Winternitz, *Verhandl. des Congress. für innere Medicin*, 1886), and the consequent carrying of cooled blood to the internal part of the body, and to the opportunities of heat dissipation offered by the dilated vessels. It seems scarcely probable, considering the crises of some of the infectious diseases, for instance, that it is due to diminished heat production. After the lapse of a few hours the temperature will usually rise again; but this is because the antipyretic effect of the bath has worn off and because the thermogenetic causes are again supreme.

Upon the *nervous system* the effects of the cold bath in asthenic diseases appear to be most salutary. Patients who have been restless fall into a quiet sleep, delirium is lessened, the intense prostration is mitigated, and stupor does not become prominent. The central nervous system retains its normal habitus much better than under other methods of treatment, and the manifestations of depression in the respiratory, cardiac, and abdominal functions are less marked.

The *respiration* is deepened by immersion in cold water, and, indeed, this is so common an experience in everyday life that it needs no elaboration. Though the immediate effect upon the *pulse* is to render it small and hard, there is an increase in the arterial tone. The superficial blood-vessels, as well as the cutaneous muscles, are all contracted, and subsequently they dilate as the peripheral resistance becomes lessened.

It is in *typhoid fever* that the greatest number of researches and experiments have been conducted as to the therapy of the cold bath. Converts to this method of treatment have been slowly made since Brand's publication in 1861, but they have been more numerous in recent years than in the two decades from 1861 to 1881. If statistics, which are always suspicious, can be relied upon, the rate of mortality by the cold-bath treatment has been marvellously diminished. But the opinions and testimony of acute and trusted observers must be accepted if we are to regard authority at all. Thus, H. C. Wood (*Therapeutics: Its Principles and Practice*, Philadelphia, 1889) writes: "I have no doubt that very many persons have died in the Unites States of typhoid fever whose lives would have been saved if the American medical profession had risen above the opposition of the laity and above its own prejudice." In Germany, Erb and Vogl have

been advocates of this form of treatment; and in France, Dujardin-Beaumetz has favoured it. Semmola, of Naples, uses it; but in Vienna and in England it has very limited use. The decreased mortality in typhoid fever can not be doubted, certainly, when the evidence comes from men of unquestioned standing. Thus, Osler (*Med. News*, vol. lxvii, No. 15, p. 393) gives these figures for the Johns Hopkins Hospital:

Patients admitted during the six years ending May 15, 1895	389
Number of deaths	34
Percentage of mortality	8·7
Patients admitted before the introduction of hydrotherapy	33
Number of deaths	8
Percentage of mortality	24·2
Patients admitted since the introduction of hydrotherapy	356
Number of deaths	26
Percentage of mortality	7·3
Number of patients bathed	299
Number of deaths among the bathed patients	20
Percentage of mortality in the bathed patients	6·6

Vogl, of Munich (*Berliner klinische Wochenschrift*, 1895, No. 29), gives these recent figures: In Munich, between 1841 and 1860, with medicinal treatment of typhoid fever, the mortality was 21 per cent.; from 1860 to 1875, with partly expectant and partly bath treatment, the mortality was 15·2 per cent. Since 1875, with bath treatment, in part combined with other therapeusis, the mortality was 6·5 per cent. He gives what must be supposed to be reliable statistics from German, French, and Austrian clinics in which the mortality is diminished from 25 per cent. under expectant treatment to respectively 7, 5, 4, 3, and 1·8 per cent. under methodical bath treatment. Vogl's patients are soldiers, who come under treatment early, and it has long been insisted upon by advocates of the bath treatment that the earlier a patient is put under its influence the better are his chances of recovery. On the other hand, the patients of Brand himself are in private practice, and his percentage of mortality is only 3·5. In general, hospital cases of typhoid fever do not come under observation until the second or third week, and a hospital percentage of 6 or 7 is therefore as highly to be regarded as a percentage in private observation of 3 or 2. The cold-bath treatment of typhoid fever is a therapeutic measure, therefore, of decided value, and must be considered as one by no means to be omitted or neglected unless special contra-indications exist.

Osler (*loc. cit.*) notes, as has been much dwelt upon by writers on this subject, that the reduction of temperature is not by any means the only benefit conferred on typhoid-fever patients by the tub bath. He points out that the furred tongue and delirium are frequently absent. And, indeed, the whole general systemic tone seems to be improved by this procedure. There is diminished vomiting; perforation and hæmorrhage are not only not increased, as might be expected, from the driving of the blood from the periphery to the interior of the body, but the chances for such emergencies seem to be diminished. Meteorism seems to be combated by the baths, and diarrhœa is less frequent. The intestinal symptoms of the disease, in general, are improved, and remain so. Delirium and stupor have been seen in cases treated by "tubbing," and the pulmonary symptoms of the disease do not seem to be favourably or unfavourably affected. Under other treatment, however, these symptoms appear and are usually expected.

There are some contra-indications to the cold-bath treatment of typhoid fever. A great repugnance on the part of the patient, coupled with fear, may make the bath injurious to him. *Diminished arterial tension*, with subsequent symptoms of *collapse* or *shock*, following the bath, should warn against its continuance. *Collapse* before the bath is a contra-indication. *Hæmorrhage* and *intestinal perforation* absolutely forbid the use of the bath, for complete rest is more essential in these conditions. Extreme *weakness* and *prostration* and pronounced *mental symptoms* are contra-indications, as well as severe *bronchitis and pleurisy* and an existing *phlebitis*. When there is coexistent *nephritis* the baths may be given with safety, for they act as diuretic agents through the increase of blood-pressure. Only when œdema or anasarca become marked and render the patient difficult to be moved has the time come to discontinue the baths. If the patient is *perspiring* freely, he may first be dried; but the perspiration itself is no contra-indication to bathing. Where there are large areas of *decubitus* it is well not to bathe the patient.

It is well before bathing to give the patient some stimulant. Some writers prefer wine or whisky combined with strychnine. Brand advises that after the bath the patient should drink a glass of cold water every fifteen minutes. In general, stimulation before and after the cold bath must depend upon the symptoms present.

On one point the writers on hydrotherapy insist most strenuously. It is that *friction* or *rubbing* must be continued as long as the patient is in the bath. If this is omitted, the patient is only chilled by his long and thorough contact with the cold water, and the subsequent dilatation of the superficial blood-vessels is delayed or lost altogether, defeating the object of the procedure. The rubbing must be carried out over all parts of the body *except the abdomen* for fear of injury to the internal coats of the intestine.

Authorities differ as to the time and need of repeating the cold plunge in typhoid fever. Some "tub" the patient whenever his temperature reaches 102° F., others at 103° F. A systematic following of this method of treatment will induce the physician employing it to resort to the bath at the temperature he believes injurious to the patient. Few men allow the temperature to go higher than 103° F., and the average temperature for placing the patient in the bath is 102·5° F. whenever this degree of fever is reached. The time varies from an hour and a half to five hours. The average number of baths given in a day changes with the patient and the severity of the disease; but the writer knows of one case in which recovery ensued in which for two days eight baths a day were administered.

The cold bath has been used with alleged success in the treatment of *typhus fever.* Opportunities for the observation of this disease are rare in this country, but the rationale of the bath would seem to indicate its proper use in typhus fever. The grave pyrexia and the intense depression offer possibilities for hydro-therapy.

In *lobar* and *broncho-pneumonia* the cold tub bath has found advocates among writers on hydriatics, though it has not met general acceptance. Baruch (*The Uses of Water in Modern Medicine*, Detroit, 1892) believes that the cold bath is a means of aborting the disease and of hastening resolution. He advises a bath at 95° reduced to 80° F. for fifteen minutes with friction. He prefers it to other treatment, especially in cases where the heart is feeble and rapid. It is claimed for this treatment that it reduces the temperature, tones the heart's action, deepens the respiration, and restores lost tone to the capillaries. It is well, however, to combine cardiac stimulants with the bath treatment.

In the treatment of *scarlatina* there is much evidence that is favourable to the cold bath. It is not maintained that complications were avoided by its use, but that the appetite and mental demeanour in severe cases were improved. The method of giving the bath in scarlet fever does not differ essentially from its administration in typhoid fever.

Diphtheria has been combated by the bath treatment with seemingly good results. But it is doubtful if this form of treatment will be considered worth while using in the face of the recent excellent results obtained from the use of the diphtheria antitoxine. Some observers, however, have alleged good results from the use of the cold bath combined with local applications of cold.

Some strikingly good results have been obtained by immersion in a cold bath in *cholera infantum.* The temperature is lowered, and the restlessness and mental disturbances become diminished. Bathing at 70° to 80° F., with cold affusions over the head, is to be recommended in this disease, especially in cases in which there is "congestion of the brain."

The high fever of *cerebro-spinal meningitis* would seem to indicate the use of the bath, and indeed it has been tried by many authors. In two cases under the writer's observation at Mt. Sinai Hospital, in New York, the patients were given a few tub baths, but they were discontinued on account of the great pain and discomfort suffered during the transference from the bed to the bath. The results of the few tubbings given, however, were very satisfactory. The patients were less restless and fell into a quiet sleep on being replaced in bed. The wet pack or cold sponging would certainly be indicated in cerebro-spinal meningitis to allay the restlessness, to reduce the fever, and give tone to the nervous system.

The cold tub-bath has been recommended for every febrile disease. Certainly in cases of profound *sepsis* with high temperature and disturbed sensorium, from whatever cause, it would find an indication. Liebermeister has used it in *small-pox, acute articular rheumatism, puerperal sepsis, quinsy,* and *erysipelas,* and believes it useful in any case with febrile symptoms of long standing. There is still much to be done in this field, but it is certainly a useful adjuvant in diseases in which prolonged high temperature is a feature, though other therapeutic measures should by no means be forgotten or neglected.

In diseases of the *nervous system* the cold bath has given good results. Patients suffering from *hysteria* and *neurasthenia* have been benefited by its use. Few such patients can endure sudden immersion in a cold plunge, and should therefore be rubbed dry with warm cloths or towels before receiving the bath. Some writers prefer first to give them a warm bath and gradually to reduce the temperature of the plunge into which the patient is placed. Should the cold plunge or bath prove greatly repugnant to the patient, or should any disagreeable after-effects be produced, the treatment must be permanently discontinued. There are some patients upon whom the baths produce actual injury; caution is demanded in giving them, as in the administration of drugs for which certain patients evince idiosyncrasy.

In the treatment of organic nervous diseases—such as *epilepsy, tabes dorsualis, myelitis,* and *paraplegias*—cold water seems to act favourably in giving tone to the entire system. The depression of the bromides in epilepsy is well counteracted by cold baths. A cure, of course, is not alleged. In the *delirium* of *alcoholism* or *cerebral excitement* from any cause a cold plunge has a quieting and calming influence. In *insane persons* sleep may often be induced by a cold bath when it is otherwise not to be obtained.

In cases of *variola, pemphigus vegetans,* and *burns* covering a large area, an ordinary portable bath tub can be used for the *permanent* or *continuous immersion* of the patient. Hebra was the first to advocate this form of treatment, and used it in his clinic in the Vienna General Hospital. The temperature of the bath can be varied at will, though it is usually kept at about the body heat. For the first few nights of immersion the patient will have difficulty in sleeping, but this insomnia can easily be overcome by the administration of some hypnotic that will not depress the heart.

The sitz-bath or *hip-bath* consists in the immersion of the hips and pelvis, with part of the abdomen, in a tub suitable for the purpose, without the submersion of the legs and thighs. The necessity of keeping the lower and upper parts of the body warmly covered is obvious.

The cold sitz-bath (50° to 55° F.) effects a slight diminution in the pulse-rate and diminishes rectal temperature. Its action on the skin and pelvic organs is antiphlogistic, and on the sexual organs it has an antaphrodisiac effect. Locally, there is a stimulation of the abdominal sympathetic system with contraction of the blood-vessels. These effects make it valuable in the therapeusis of inflammatory processes.

In the treatment of *genito-urinary affections* of the male and female it plays a conspicuous rôle. In *atonic* conditions of the *bladder* and

seminal vesicles, in *prostatorrhœa*, in *nocturnal incontinence of urine*, and in too frequent *seminal emissions*, it is a useful measure. In *chronic posterior urethritis* and in *cystitis* the cold sitz-bath has been found beneficial. In *chordee* and *priapism* the cold sitz-bath reduces the spasmodic contraction. On *internal* and *external hæmorrhoids* it has a favourable action; and, in fact, in all conditions in which there is congestion or stasis of the portal or pelvic circulation the sitz-bath may properly be used. Acute inflammation of any pelvic organ, cardiac disease, and neuralgia involving any of the pelvic nerves or their branches, are contra-indications to the cold sitz-bath.

The hot sitz-bath (90° to 95° F.) is of more benefit in acute than in chronic pelvic disease. *Acute parametritis* and *perimetritis* yield well to a hot sitz-bath administered twice daily. *Strangulated herniæ* and *hæmorrhoids* may sometimes be reduced after lessening of the spasmodic muscular contractility by the hot sitz-bath. After prolonged *retention of urine*, where other measures have failed to produce spontaneous evacuation of the bladder, the patient will often pass urine in the sitz-bath. This is true whether the difficulty is due to a stricture of the urethra or to some spasmodic condition of the bladder. Friction is often practised after the sitz-bath in the same manner as it is done after the cold tub-bath.

The warm tub-bath or *hot bath* is, as its name indicates, a bath with a temperature of from 80° to 105° F. It has a widespread use and is valuable in many conditions of acute and chronic disease. Care must be exercised in the selection of patients before submitting them to this measure, for in persons suffering from *cardiac disease* the change produced in blood-pressure after removal from a hot bath may act dangerously upon a heart not equal to sudden calls. The hot bath stimulates the force and frequency of the heart-beat by a general diminution of blood-pressure due to the cutaneous vascular dilatation. Under its influence the skin becomes red and the patient perspires freely. It is partly because of this increase of the amount of blood in the cutaneous area that the warm bath is of value as a therapeutic agent. By its calming effect upon the central nervous system it acts as a decided sedative; the drowsiness and languor following a hot or warm bath are recognised by the laity. It has been experimentally observed that a warm bath causes a diminution in the calibre of the vessels of the pia mater, and on this ground may be explained its hypnotic action.

Clinically, the warm bath has a host of applications. It has been recommended—at a temperature of 95° F.—as a stimulant to the kidneys where there is total or partial *suppression of urine*. In *diseases of the liver* with marked *icterus* it is believed that some of the circulating bile may be excreted through the kidneys and skin under the influence of a moderately warm bath. In *cardiac disease*, where there is no venous stasis, a tepid bath may be of service; but the attendant must be careful that the patient rests in bed after the bath and is properly dried with warm cloths without unnecessary friction.

Some writers have found the increased depth of respirations and more vigorous coughing induced by the warm bath combined with cold douches of use in diphtheria. It is likely, however, that the use of the antitoxine of diphtheria will render other measures of little account in the treatment of this disease. Because of the same phenomena, tepid baths have availed in the treatment of *bronchitis*, acting indirectly as an expectorant. In *pneumonia*, a bath with a temperature of from 85° to 90° F. produces deepened respiration, increase of expectoration, together with a sense of refreshment and relief. The bath is not indicated, however, when the disease is running a favourable course. Should the fever be very high and the nervous symptoms pronounced, the bath can be reduced to a temperature of 80° or 77° F.

Diaphoresis in *renal disease* can be assisted by the hot bath at a temperature varying from 95° to 105° F. Existing *dropsy* can be well combated in this way, and sometimes disappears in a remarkably short time after the repeated administration of hot baths followed by a pack. After his removal from the bath, in which the patient remains from half an hour to an hour, he is placed in a previously warmed bed and wrapped in warm blankets up to the neck. To promote and stimulate diaphoresis, the patient should be given hot drinks during the pack. Not all patients can endure the hot bath and pack, and cases must be carefully selected.

In *cerebral hyperæmia* and *cerebral hæmorrhage* moderately warm baths seem to have a beneficial effect. Their temperature should not be above 93° F. Lukewarm baths act favourably as a sedative in the *chorea* of children. Tepid baths are recommended in the treatment of *multiple sclerosis of the spinal cord* and the *progressive general paralysis of the insane*—not, indeed, as curative, but as palliative measures. Baths of a temperature of 85° to 90° F. do good service in *chronic myelitis*, particularly when spastic symptoms predominate. The baths should not be too warm, nor should they be continued for too long a time, nor be given oftener than thrice weekly. In the treatment of convalescents from *acute neuritis*, from whatever cause, warm baths with the addition of common salt are sometimes of value in restoring tone to the degenerated nerve-fibres. Massage combined with warm baths is recommended for *paralysis agitans* and in the treatment of *paralysis of the extremities*.

When a patient suffering from *pyelitis* has difficulty in sleeping, a warm bath given just before bedtime will often produce the desired effect. For hypnotic purposes a similar procedure may be used in a variety of conditions, but care must be observed that the patient is thoroughly dried after emersion from the bath.

A full hot bath may sometimes supersede the hot sitz-bath when the latter can not be given. Its indications are *sexual disorders* in the male and female, and such conditions as

vesical spasm. Strangulated herniæ may return under the influence of heat, as in the use of the sitz-bath.

In *cholera infantum* a hot bath containing mustard may relieve the intestinal congestion and aid the cutaneous circulation. The value of the hot mustard-bath in convulsions of children has been overrated, however, and it is altogether likely that such seizures would have terminated spontaneously by the time the bath is made ready for use.

Sir Benjamin Ward Richardson has recently called attention to the value of a bath at the body temperature as a diagnostic measure (*Asclepiad*, vol. xi, No. 43). Patients suffering from diseased conditions in the abdomen are immersed for fifteen minutes. The abdominal walls, in obese as in thin subjects, become flaccid, and the abdominal organs are more easily palpable.

The *drip bath* or *sheet bath* is a substitute for the cold tub-bath in conditions of *pyrexia* in *acute disease* or in *chronic nervous disease.* It is carried out by enveloping the patient's trunk and extremities in a sheet previously wrung out in water of a temperature of from 60° to 85° F. The first fold of the sheet is passed between the body and the arms, the second over the arms and shoulders. Active friction must be kept up by the attendant over all portions of the body covered with the sheet. This prevents shock and keeps up the tone of the peripheral vessels as it does in the cold bath. Cold affusions over the head must be maintained during the sheet bath. For antipyretic effect, the bath should be kept up for fifteen or twenty minutes, but a much shorter time suffices for the undoubted tonic effect. For the latter purpose, the sheet bath is recommended in *neurasthenia*, *anæmia*, and *metabolic disturbances.* Von Ziemssen indorses its use in the treatment of *phthisis.* In all the acute diseases with pyrexia, when the patient can not endure the more heroic tub bath or where it is impossible to use it, the sheet bath is a good substitute. It reduces the temperature and acts as a nervous stimulant in the same manner as a tub bath. It is not as fatiguing or as troublesome as the full bath, and is more agreeable to the patient. When administered for its antithermic effect, the sheet must be cooled off from time to time by pouring cold water over it, for a temperature on the patient's part of 102·5° F. heats the sheet rapidly.

The sheet bath may be applied with the patient in bed or standing. In the former event the bed must be protected by a rubber sheet or blanket on which rest a few thicknesses of sheets for the comfort of the patient. When the patient stands, the sheet is wound about his neck, over the arms and shoulders and thighs. The antipyretic action of the sheet bath is accomplished in the same manner as in the tub bath. If the patient complains of feeling cold or actually shivers, the sheet must be removed at once.

The *wet pack* consists in enveloping a patient in a linen sheet which has been wrung out of water at a temperature of from 50° to 70° F., which in turn is covered with one or two blankets. The sheet must thoroughly cover the patient from head to feet, and must rest between the arms and the body and between the thighs. The blanket must fit snugly about the patient's neck and his feet so that air is absolutely excluded. The head, at the same time, has about it a towel wrung out of cold water. As soon as the pack becomes warm through radiation from the body, a second pack is brought into requisition of a temperature two degrees higher. Baruch states that five such wet packs, each one of ten minutes' duration and each one two degrees higher than its predecessor, will reduce a temperature as well as a fifteen-minute tub bath at 65° F. The action of the wet pack depends upon the interchange of temperature going on between the skin and the sheet, so that as the warm blood is driven to the periphery a vapour is formed which completely envelopes the patient and can not escape because of the closure of the sheet and blanket at his neck and feet. The advantages alleged for the wet pack are *antithermic*, *diaphoretic*, and *stimulant* in *functional neuroses.* Under its influence patients fall asleep more readily even than in the warm bath. It is recommended for diseases in which there is impaired metabolism, such as *diabetes*, *rheumatism*, and *gout.* Baruch (*loc. cit.*) reports good results from its use in *functional cardiac disorders* and in *organic cardiac disease* with disturbed compensation. In *acute pyrexia* the wet pack may replace the tub bath, but it takes longer to accomplish the same result. It should always be followed by some active hydriatic procedure—an affusion or douche. The disadvantage of the wet pack, aside from the time it consumes, lies in the sudden shock the patient experiences when placed upon a cold, wet sheet.

The *half bath* is administered in a long tub containing from six to twelve inches of water, covering the legs and thighs of the patient. The water bears a temperature, varying with each case, of from 50° to 80° F. While the patient sits or reclines in the tub an attendant throws water from the tub over his chest and back, using gentle friction at the same time. The lower extremities are massaged by another attendant, and the patient assists by rubbing his chest with cold water if he is not too weak. The head, as in other hydriatic procedures, is inclosed in a wet towel. Colder water is added to the bath from time to time. The bath may be repeated in from six to eight hours. The half bath may be begun at a temperature of 90° F. and gradually reduced to 78° F. while the patient is in the bath. The beginning temperature of the bath may be gradually reduced from day to day.

The therapeutic applications of the half bath are great *excitement* and *nervousness*, threatening *delirium* or *stupor*, *weak cardiac action*, *insomnia*, and *neurasthenia.* The skin assumes a ruddy hue, the pulse becomes better in quality and frequency, and respiration is deepened. After the use of the wet pack the half bath is a valuable measure in restoring cutaneous circulation and improving the nervous tone. Upon emerging from it, the patient

should be thoroughly dried with a rough towel or coarse sheet.

Affusions consist in the simple dashing of cold water (75° to 60° F.) upon the body. This can be accomplished by placing a rubber sheet under the patient and applying the water with the hand or a towel. The good effect is obtained by the shock to the peripheral nerves, and the consequent reaction upon the cutaneous vessels.

Of more value as an antipyretic agent is the *sponge bath*, or *cold sponging*. This is carried out in *acute febrile conditions* by rubbing the patient repeatedly from head to foot with cold water (75° to 60° F.). The effect does not last as long as that of the tub bath, and the procedure must be renewed from time to time as the temperature rises. The antithermic influence may be enhanced by the addition to the water of one third of its bulk of alcohol. Evaporation proceeds more rapidly. A fall of from one to three degrees of temperature may be induced by a sponge bath. It refreshes and stimulates the patient at the same time that it acts as an antipyretic. In *scarlatina, typhoid* and *typhus fevers*, and in *sepsis* from any cause, cold spongings are of value.

Douches in the hydriatic sense consist in the application of hot or cold water to the surface of the body or its cavities. They are applied through a hose from a constant or temporary supply *under pressure*. Elaborate appliances are in use for this purpose in water-cure establishments, but a douche can be given through a hose attached to the faucet of a bath tub or from an overhead shower.

The douche should never be given for a greater length of time than five minutes, and if it is cold, not longer than one minute over one area. By its action the circulation is increased in efficiency, the nerve-centres are stimulated, and respiratory movements are deepened. Charcot recommended the douche in *hysteria* and *neurasthenia*. For this purpose the douche may be begun at a temperature of 90° F., and reduced one or two degrees daily. In *general lassitude with anæmia* a douche of the same temperature is indicated, and is a valuable adjuvant to other treatment. In *chronic gastric disease*, in simple *anæmia*, in *chlorosis*, in *gout*, and in *rheumatism* cold douches are very serviceable. In the treatment of *diseases of the spinal cord* warm douches have proved satisfactory in refreshing the patient and giving tone to the nervous system. Baruch points out that in *erethetic forms of neurasthenia* the douche is contra-indicated. Gynæcological douches have already been considered, and rectal irrigation will be described farther on.

Lavage of the stomach is practised as a therapeutic and diagnostic measure. It includes siphonage of the stomach contents. In cases of *acute poisoning by the vegetable poisons*, washing out of the stomach is immediately indicated. In the case of the escharotic poisons it is a dangerous procedure, as the coats of the œsophagus may have become so deeply involved as to present a liability to perforation. When *solid opium* has been ingested lavage is of little avail, and the mineral acids are so rapidly absorbed that siphonage of the gastric contents is of meagre therapeutic use. In *lead* and *mercury poisoning* it may be practised in the absence of antidotes and emetics.

In *chronic gastritis* no remedy gives greater relief to the patient or more hastens the cure than lavage of the stomach. By means of it the viscus is cleared of the products of abnormal fermentation and decomposition which do much to impair its digestive powers. The large amount of mucus which collects abnormally in chronic gastritis is also removed by this process. The process acts not only as a cleansing one, but as a stimulant one as well. In *dilatation of the stomach*, where it is desirable to relieve the distended organ of its accumulated abnormal contents, lavage meets the indication well by removing the mechanical and chemical irritants which tend to keep up the condition.

Irrigation of the stomach, as recommended by Kussmaul in 1882 for *intestinal obstruction*, has yielded some good results by inducing rest, sleep, and a reduction of the impediment. But after its use it may still be necessary to interfere surgically in order to save the patient's life.

Force must never be exerted in passing the stomach-tube, since injury to the coats of the œsophagus may occur. The presence of a thoracic aneurysm is an absolute contra-indication to the practice of lavage, for obvious reasons; ulcer of the stomach and phlegmonous gastritis, when diagnosticated, also forbid the use of the tube.

The use of water by the *rectum*, in the form of enemata, is indicated in a variety of conditions. The *summer diarrhœa of infants* may be hastened toward convalescence by intestinal irrigation with water at 95° F. For this purpose a Nélaton catheter of soft rubber answers the purpose. The tube is passed gently through the rectum, as high as the transverse colon when possible, and water that has been thoroughly boiled is allowed to run in from a fountain syringe. In introducing the tube an important point to remember is to pass it first *backward* and then to the *left*. The water may contain a normal solution of sodium chloride, or may hold starch in suspension.

In cases of *shock*, whether due or not to surgical interference, an enema of hot water (110° F.) is a valuable stimulant. When there has been a large loss of blood from any cause the same procedure is of inestimable benefit. To hasten absorption, it is well to add sodium chloride to the physiological strength (0·6 per cent.); and in order that the enema may not be expelled at once, the addition of opium is to be urged.

In *acute dysentery* of adults and of children irrigation of the rectum and colon with warm water yields good results by freeing the mucous membrane of its foreign matter. In *colic caused by poisons* lavage of the lower intestinal tract has been recommended.

After *severe loss of blood* during or following an operation an enema of water or an intra-

venous or intra-arterial infusion is of the highest value. To promote absorption, the water should contain a normal percentage of sodium chloride (0·6 per cent.). A hot enema of 6 oz. of water is a valuable therapeutic measure in *shock*.

BENJAMIN F. WESTBROOK.
SAMUEL M. BRICKNER.

HYDRIODIC ACID, HI, is a colourless gas that may be produced by the action of iodine on phosphorus, in the presence of water, by means of moderate heat. The pure acid fumes when exposed to the air, and by its affinity for water forms liquid hydriodic acid in saturated aqueous solution. The latter is colourless when first prepared, but gradually darkens in consequence of the liberation of iodine and eventually deposits iodine crystals. The liquid acid produces all the effects of iodine, and it may be given in all conditions in which that agent is applicable, in doses of from 5 to 30 drops, diluted with water. But the use of the unofficial liquid acid has been supplanted largely by that of the official syrup of hydriodic acid, *syrupus acidi hydriodici* (U. S. Ph.), which contains 1 per cent. of absolute hydriodic acid. The mixture is then filtered through a small rapidly acting white filter; carefully wash the phial, and filter with dilute alcohol until the filtrate ceases to produce more than a faint cloudiness, when a drop or two is allowed to fall into a silver-nitrate test solution. The filtrate is reduced by evaporation on a water bath to 1 oz., 334 grains, and mixed when cold with enough syrup to make the product weigh 35 oz. The syrup is an odourless, transparent, colourless, or straw-coloured liquid that has a sweet and acid taste.

Syrup of hydriodic acid is a valuable means of administering iodine, for it is a preparation that is palatable and not likely to derange the stomach. In the so-called *scrofulous diathesis* of children this syrup is a very useful remedy. In *delayed resolution* of the lungs after *pneumonia* the syrup seems to accelerate the absorption of the exudation products and hastens the restoration of the normal condition of the pulmonary parenchyma. So, too, in the slow absorption of *pleuritic exudation* the syrup is of benefit. It is useful as a remedy for *asthma*, decreasing the frequency and intensity of the paroxysms. It may be used instead of the iodides in the treatment of *lead poisoning*, either acute or chronic. It has been recommended as a useful remedy in the treatment of *acute rheumatism*. The dose is from 20 to 240 minims, well diluted.

SAMUEL T. ARMSTRONG.

HYDRIODIC ETHER.—See ETHYL IODIDE.

HYDROBROMIC ACID is a gas composed of bromine and hydrogen, and is official only in a dilute solution, *acidum hydrobromicum dilutum* (U. S. Ph., Br. Ph.), which contains but 10 per cent. of absolute hydrobromic acid. It is a clear, colourless, odourless solution possessing an acid taste; each drachm equals 9 grs. of potassium bromide. It was introduced as a therapeutic agent by Dr. Wade, and its physiological action was carefully investigated by Dr. E. T. Reichert, who found that it closely resembled potassium bromide in its action upon the nervous system and the circulation; in moderate doses it produced ephemeral elevation of the blood-pressure, and in large doses it directly paralyzed the heart and, to a lesser degree, the voluntary muscles.

While it was originally recommended as a substitute for the bromides, experience has shown that remedial doses are more irritant to the stomach than the bromide salts, though, unlike the latter, they do not produce muscular depression or acne. The therapeutic properties of hydrobromic acid resemble those of the bromides; it may be used in their stead and is much pleasanter to take. It may be administered either with syrup, simple elixir, or water, or it may be combined with one of the bromides. The latter combination is recommended for *epilepsy*. Its anodyne effects may be brought into play to relieve *headache* due to eye-strain or neurasthenia, for the relief of *nervous cough*, and in some mild *neuralgias*. The writer has found it most useful when associated with quinine, as it not only dissolves the latter, making a rather pleasant compound, but prevents *tinnitus aurium*. Enough acid should be used to make the quinine dissolve in a little water, and lemon syrup is added to complete the quantity of mixture desired. The official quinine hydrobromate is less satisfactory than the mixture of quinine sulphate in hydrobromic acid. The dose of the acid is from 5 to 120 minims, two to four times a day.

SAMUEL T. ARMSTRONG.

HYDROBROMIC ETHER.—See ETHYL BROMIDE.

HYDROCHLORIC ACID, the *acidum hydrochloricum* of the pharmacopœias, is rarely used externally as a caustic, being decidedly inferior to nitric and sulphuric acids, but if nothing else is at hand, it may be employed for the destruction of small superficial growths, such as *warts*. For this purpose the ordinary commercial acid is entirely appropriate, but for internal administration it is hardly suitable, as it may contain arsenic or lead derived from the reagents employed in its manufacture. As it is used very largely in the arts, numerous accidents in the shape of burns occur from it, but they demand no special treatment beyond that mentioned under the head of acids. When it is swallowed accidentally its effects are similar to those of the other mineral acids, except that they are not usually so severe. Occasionally, if the person is seen shortly after the accident has occurred, the distinctive odour of the acid may be detected in the breath, as also whitish pungent vapours issuing from the mouth. The undiluted official acid may be given in doses of from 5 to 10 drops, freely diluted in water, but the diluted acid, *acidum hydrochloricum dilutum*, is to be preferred, as it contains only about one third of the amount of acid, and is much less apt to be the source of the accident of corrosion or overdosing. Under ordinary circumstances the maximum dose of this latter preparation should

not exceed 30 minims, which must be well diluted with water, and if possible taken through a glass tube.

Hydrochloric acid is held by some to be decidedly inferior to lactic acid in the treatment of various forms of *indigestion*, but unless the latter is of the best quality, hydrochloric acid is to be preferred, and is nearly if not quite as effectual. Scarcely any remedy achieves more brilliant results than this acid when given for the relief of the formation of considerable amounts of gas in the stomach within a short time after eating; whether it actually assists in the proper digestion of the food or operates by checking the multiplication of the micro-organisms supposed to be at the bottom of the trouble, is of little account, as practical experience shows that its administration after meals for a few days is almost invariably followed by the disappearance of the feeling of oppression, acid eructations, and palpitation of the heart which are often so distressing and arouse in the patient the liveliest apprehensions of serious cardiac trouble. It is often desirable to combine pepsin or nux vomica or both with the acid when the secretion of the gastric juice seems to be scanty. Ordinary mild *acid dyspepsia with pyrosis* also is a condition benefited by its use after eating, but cases exist in which the eructations are decidedly acid and occur almost immediately after eating, and in which it is evident that there is an oversecretion of the acid elements of the gastric juice. In these cases the acid should be given before eating, as the secretion of the gastric juice is thereby diminished. Conditions in which alkaline eructations occur are benefited by its administration after eating.

The conditions mentioned often overlap to such an extent that an intelligent diagnosis is almost impossible, and it is rather safer to administer the acid before eating at first, and if no benefit results in a few days, try it after meals. In the *indigestion of phthisis* hydrochloric acid is usually of good service, and may be given alone or in combination with any of the bitter tonics or with pepsin. As an adjuvant in any treatment for *acute rheumatism*, save the alkaline, it is of considerable value on account of its effect upon digestion, and there are some grounds for ascribing to it a direct specific effect. In all the *febrile conditions* it relieves the dryness of the mucous membrane of the mouth and throat, and aids the digestion. It often assists in checking the *diarrhœa of typhoid fever*. One part of the dilute acid in ten parts of water may be used as a gargle in *scarlet fever* with good results. In the *phosphatic diathesis* it may be employed, but is hardly so useful as nitric acid.

The *sore mouth* which so often accompanies indigestion is often relieved by the local use of this acid, which may also be employed as a mild stimulant of *unhealthy suppurating surfaces*. The *itching* of urticaria and other cutaneous affections, also *profuse sweating*, may be relieved by sponging with very weak aqueous solutions. Scarcely any of the ordinary medicinal substances in use are incompatible with it, save silver, and it may be safely incorporated in almost any mixtures. In *poisoning by silver* and *alkalies* it may be used, but in the latter case is not so suitable as sulphuric acid, as its salts are usually soluble and somewhat irritating. The dose of the dilute acid need not exceed 5 minims to begin with, but may be increased safely to the maximum above mentioned. Its too prolonged use is apt to be followed by a diminution of the secretion of the gastric juice, and thus the conditions for which it is prescribed may be aggravated and diarrhœa and emaciation may follow.

[Dr. Henri Huchard (*Jour. des praticiens*, 1895, No. 7; *Am. Jour. of the Med. Sci.*, May, 1895) thinks that hydrochloric acid is indicated in *heart disease with deficient compensation*, in *chlorosis*, in *anæmia*, and in *neurasthenia*. Its use, he says, should be continued for three or four weeks, omitted for a fortnight, and then resumed. He disapproves of the large doses recommended by Ewald.]—Russell H. Nevins.

HYDROCHLORIC ETHER.—See Ethyl chloride.

HYDROCOTYLE ASIATICA, Indian pennywort, is a small umbelliferous plant indigenous to India and southern Africa. The leaves have been esteemed as an alterative. J. Lépine isolated from them an oleaginous substance that is called *vellarine*; it has the characteristic odour of the plant and a bitter pungent taste. An infusion of the leaves is used in East Indian countries as a diuretic in *fever*, as an astringent in *catarrhal enterocolitis*, as an alterative in *syphilis*, and as a remedial agent in *lepra*, *lupus*, and *scrofuloderma*.—Samuel T. Armstrong.

HYDROCYANIC ACID, prussic acid (Scheele, 1780), CNH, is a thin, limpid, colourless fluid, highly volatile, extremely unstable, and intensely poisonous. It has a characteristic, peculiar odour, a hot, bitter taste—that of the oil of bitter almonds—and so little constancy as to decompose rapidly into worthless products of a black colour which look like ink. Mixture with water makes it more persistent, and in proportion to the admixture, so that the more diluted it is the longer it keeps. It decomposes rapidly, even under perfect exclusion of the air, is coloured yellowish-brown, then brown, and deposits with the formation of ammonia an amorphous brownish-black mass. Decomposition is hastened by exposure to light, so that the solution should be kept in small phials, stopped with cork rather than glass, in a cool place, and should be dispensed by means of a pipette rather than by pouring. With these precautions the solution may be kept pure for years (Squibb). The vapour is so diffusible that it readily transudes by osmosis all porous membranes, and soon escapes from viscera unless they are confined in good cork-stoppered glass vessels.

Hydrocyanic acid is a feeble but true acid; it reddens litmus, and forms, with the basic metal oxides, salts and cyanides, which may be separated by the action of strong acids. Chemically pure prussic acid can not be handled, and there is no case known where the action of it

has been indubitably established. The substances usually called prussic acid are solutions in water or alcohol. Official solutions have various strength, mostly 2 per cent. The former official solution of the Pruss., Hamb., and Hannover Ph's had 2 per cent., as have the present official solutions of the Austr., Neth., U. S., and Br. Ph's (the *acidum hydrocyanicum dilutum* of the U. S. and Br. Ph's). Others have 3 per cent. The solution of Scheele had 4 to 5 per cent.; the official French preparation is 10 per cent.; that formerly used by Majendie, 15 per cent.; that by Robiquet, 50 per cent.

There is an ethereal bitter-almond oil sold in the shops which contains more hydrocyanic acid (from 3 to 14 per cent.) than the official acid. This preparation may be the source of dangerous intoxication, even in external use, as in hair oils, etc. At the Hôtel Bicêtre, in Paris, seven epileptic patients were killed by the use of a solution of prussic aeid of from 14 to 15 per cent. which had been substituted for a 2-per-eent. solution.

Prussic acid is found in all vegetable matters which contain amygdalin, as in bitter almonds, up to 4 per eent., in the seeds of peaches, apricots, cherries, plums, and pears, and in the leaves and berries of the cherry-laurel. The seeds of ten common apples, distilled in water, do not yield in the distillate the slightest trace of prussic acid, but when they are bruised and redistilled there is found a mere traee of it.

One hundred parts of amygdalin furnish two parts of pure prussic acid, free of water. Parts of plants which contain this glucoside furnish on distillation a fluid which contains the two products, prussic acid and oil of bitter almonds, with their charaeteristic odour and taste. In this way are prepared the official bitter-almond water and cherry-laurel water. The alcoholie drinks derived from cherry stones and prunes, the so-called Kirschwasser and Maraschino, contain perceptible amounts of prussic acid.

It is well known that the *Cassava*, or tapioca plant, contains prussie acid in its roots, and this plant has been the means of repeated poisoning by prussic acid in tropical countries. Prussic acid is contained also in the seeds of *Lucuma mammosa* and in the beans of the mottled variety of *Phaseolus lunatus.* These plants have caused dangerous intoxication in the Mauritius by being mistaken for edible varieties. Prussie acid develops from these plants only after mixture with water under the process of fermentation. Gershoff found amorphous amygdalin in various Japanese plants, for instance, in the leaves of *Pygeum parviflorum* and *Pygeum latifolium;* further, in the *Asclepiadaceæ, Gymnema latifolium.* The leaves of this plant, when fresh, are free of odour, but they develop under slow drying a strong odour of bitter almonds and prussic aeid, which is not present in the fresh leaves, but may be distilled from the dry leaves. The fruit buds of various Japanese *Aroideæ*, especially of the genus *Lasia*, furnish prussic acid in great quantities. The cutting or crushing of these parts develops an odour so intense as to produce dyspnœa, a feeling of constriction, and vertigo. *Pangium edule* contains hydrocyanic acid, not only in the seed (0·07 per cent.), but also in the bark (0·012 per cent.), and espeeially in the leaves (0·34 per cent. in the moist leaves, *i. e.*, more than 1 per cent. in the dry substance). In these parts the prussic acid is either free or only very loosely combined with a strongly deeomposing substance supposed to be a sugar. A similar conneetion is found in *Hydnocarpus*, which, as the *Hydnocarpus inebrians*, serves as a fish poison in Ceylon. Prussic acid has been demonstrated also in eertain non-tropical plants, for instance in *Agaricus* and in the flowers of *Ribes aureum* (Husemann).

In the animal kingdom, prussic acid has been found in certain wood lice of the family of the *Diplopoda*, as in *Polydesmus gracilis*, found in hothouses. This inseet has upon the back, as means of defence, so-called foramina repugnatoria, through which, when the animal is seized, the glands of the skin excrete a prussie-acid fluid.

Hydroeyanic aeid is found normally in the body only in the sulphocyanate of the saliva, and then only in infinitesimal quantity. It has never been demonstrated as a product of putrefaction.

The cyanides of potassium, sulphur, gold, and mercury, by liberating the acid, produce its charaeteristic features. The most important salt is the potassium cyanide, a white salt, insoluble in water, with an alkaline reaction, much employed by photographers, electroplaters, gilders, etc., and hence of easy access everywhere. Potassium cyanide has a bitter taste, with a sense of coldness, followed by contraction and heat. Sulphocyanate of mercury is the material of whieh the toys called Pharoah's serpents are made. A few cases of irritant poisoning by swallowing these toys have been recorded.

Besides the substances mentioned, the non-poisonous cyanides, such as the ferrocyanide of potassium, may become poisonous when hydrocyanic acid is liberated under the presence of free hydrochloric acid in the stomach. Other cyanide compounds, such as the sulphocyanide and the cyanide of chlorine and iodine, are likewise more or less poisonous, but have no practical interest. The same may be said of other organic cyanide compounds, like methylcarbylamine, the essential substance of the poison of the crotalus, etc. In the animal kingdom, further, prussic acid has lately been found as stated in the secretion of the sebaceous glands of certain species of centipedes.

Bitter-almond water, *aqua amygdalæ amaræ* (U. S. Ph.), *aqua amygdalarum amarum* (Ger. Ph.), contains 0·1 per cent. of hydrocyanic acid. Cherry-laurel water, *aqua laurocerasi* (Br. Ph.), contains usually about ⅟₁₀ of 1 per cent. of hydrocyanic acid. It has an interesting history as the precursor of hydrocyanic acid. It was the agent used by Donellan in the murder of Sir Theodosius Boughton in 1781, and by Price, the last claimant of the discovery of the transmutation of the baser metals into gold, to make away with himself in 1784,

when the falsity of his claim was about to be demonstrated (Witthaus). The external application of the leaves of the cherry laurel to ulcers has also given rise to intoxication.

Chemically pure hydrocyanic acid, free of water, is the most rapidly destructive poison that is known. Next to it rank pure nicotine and coniine. The most cautious smelling of it produces irritation of the throat, obtunding of the sense of smell, vertigo, and confusion. Stronger smelling may produce death in a very short time. A medical practitioner, while showing to some friends the effects of Scheele's prussic acid on an animal, accidentally allowed some of it to fall on the dress of a lady who was standing before the fire. The lady was immediately seized with dizziness, stupor, inability to stand, and faintness, and was revived only after stimulation for ten minutes. Regnauld reported the case of a student who nearly lost his life by inspiring the vapour as it escaped from a flask in which he was preparing it. The writer was once called to treat the case of a coloured boy who was found lying on the floor insensible from inhalation of the fumes of potassium cyanide used in cleaning stains from a carpet.

The poisoning which sometimes occurs from the use of bitter-almond oil in hair oils, liniments, etc., finds its explanation partly in inhalation of the vapour of prussic acid by the lungs.

Prussic acid produces insensibility and loss of muscular power quicker than any other poison. A drop of the dehydrated acid introduced anywhere into the blood, *per os* or *per anum*, through any mucous membrane or a wound, produces death in a few seconds.

But this intensity of poisoning is true only of the rapidity of its action and not of the minuteness of the dose, for, in comparison with other poisons, a dose to be fatal must be quite large. It takes, even of the dehydrated prussic acid, as much as a drop—that is, 0·05 to 0·06 of a gramme—to kill an adult human being, and of the pure potassium cyanide about 0·15 to 0·25 of a gramme. But, as remarked, nothing else acts so quickly. The symptoms of poisoning, especially after the inhalation of very strong solutions of the free volatile acid, may be concentrated into a few seconds. When a large dose has been taken, from $\frac{1}{2}$ oz. to 1 oz., the symptoms commence in the act of swallowing. It is rare that their appearance is delayed beyond one or two minutes. There is no time often for appreciation of the symptoms. Hence the preference of this poison by the would-be suicide.

The easy decomposition of prussic acid makes it difficult to determine the minimum fatal dose. As the result of numerous observations it may be assumed that the smallest fatal dose for adults of the dehydrated prussic acid is from 0·05 to 0·06 of a gramme (from 0·77 to 0·92 of a grain). In certain cases a quantity of from 0·04 to 0·045 of a gramme (from 0·62 to 0·70 of a grain) has been regarded as the cause of death, but there are other observations in which, under proper treatment, the ingestion of as much as from 0·1 to 0·15 of a gramme ($2\frac{1}{4}$ grains) has been survived. The experiments of Nunneley on animals show that the repeated administration of small doses in quick succession may lead to acute prussic-acid poisoning.

One grain of anhydrous acid is given by Taylor as the nearest approach that we can make to the smallest fatal dose, though a case was recorded by Mr. Hicks of a healthy woman who died in twenty minutes after taking the equivalent of $\frac{9}{10}$ of a grain. The products of commerce are, however, so often impure, by admixture with potassium carbonate, that even ten times this dose may be endured. In individual doses very diluted solutions of the crude oil of bitter almonds sold in commerce, 17 drops, and large doses of bitter-almond water, 900 grains, and bitter almonds themselves, have produced poisoning.

In children the eating of ten almonds, in adults sixty to seventy bitter almonds, may suffice to induce fatal poisoning. Potassium cyanide in a dose of 5 grains has proved fatal in three instances, in one case in the course of two hours. Cherry-laurel water is responsible for but few deaths. A quantity of 45 grammes (about 675 grains) produced the death of a man in half an hour; 60 grammes (about 900 grains) killed a man in five hours (Casper). Donellan, in 1781, killed his brother-in-law, Boughton, in the case referred to, with a dose of 60 grammes.

Use.—Prussic acid was recommended by West in the treatment of *whooping-cough*, and in England extensive use was made of it in treatment of affections of the heart, in *beginning hyperthrophy*, *nervous palpitations*, *præcordial anxiety*, and *angina pectoris*, but the number of sudden deaths which have occurred after the use of medicinal doses should lead to the greatest caution, and should really reject the remedy altogether.

Hydrocyanic acid has little or no medicinal virtue, and should, on account of its danger (*primum non nocere*), be banished from the shop of the apothecary and the pages of the materia medica. It had formerly a reputation as a sedative, and was often prescribed, especially with morphine, for the relief of nausea and pain in the stomach. It is very questionable, however, if it possesses any such virtue. Nevertheless, the preparations, especially cherry-laurel water, are much used as vehicles, and the odour is preferred by many patients to that of peppermint or other aromatic. It is unfortunate that the solutions vary so much in strength. As the virtue of the solution depends upon the odour (suggestion), which is retained in almost infinite dilution, the preparation when dispensed medicinally should be always diluted with distilled water many times. The dose of dilute hydrocyanic acid should never exceed $\frac{1}{4}$ of a drop, or that of bitter-almond water or cherry-laurel water from 10 to 15 drops. It should be known that solutions of the hydrochloride of morphine in these waters decompose with the separation of oxydimorphine.

Chlorine water, nitric acid, and all oxidizing agents are incompatible with prussic-acid

preparations, because they quickly change the cyanic combinations into formalic acid. Equally incompatible are metallic oxides and alkalies.

[The statement that hydrocyanic acid is too dangerous a substance to use as a remedy applies also to the inhalation of its vapour, *vapor acidi hydrocyanici* (Br. Ph.)].

Hydrocyanic acid has in medicine mostly a forensic interest as the cause of poisoning, usually fatal, by suicide or homicide, by accident or design.

The reports of the registered *Journal of Great Britain*, 1863 to 1867, include 253 cases of poisoning from all causes, of which 151 were caused by hydrocyanic acid and cyanide of potassium, a number only exceeded by cases of poisoning with laudanum and the salts of lead. During the same period there were 6,696 suicides, of which 673 were by poison, and of these the cyanic poisons head the list with 121 cases. Of 1,263 murders, 19 were by poisons, and of these, 5 were by laudanum and 5 by the cyanide poisons. Of 431 cases of poisoning in Berlin from 1876 to 1882, 74 were by cyanide of potassium and 12 by hydrocyanic acid (Witthaus). According to the annual report of Innhauser and Nusser, Vienna, 1873, of 46 suicides by poison, 17 were caused by potassium cyanide. In 1873, according to Hoffmann, 32 of 63 suicides, in 1875, 27 of 57 suicides, were caused by potassium cyanide. The cyanide combinations have come, in recent years, more and more into favour as means of suicide, as formerly they were used only by chemists, druggists, physicians, and naturalists, and later by photographers; now, however, by all classes.

Hydrocyanic acid is not always taken by the mouth. In a case reported by Carrière, potassium cyanide was introduced by clyster. It acts with the same rapidity and certainty when applied to the mucous membrane of the conjunctiva, rectum, or vagina. Application to the external auditory canal and to the glans penis is likewise poisonous. Absorption from the rectum follows with nearly the same rapidity as from the stomach. But absorption from the subcutaneous tissue and from fresh wounds is less rapid than is generally believed. The application to the skin is of course the least dangerous.

Poisoning of others by prussic acid is, on the whole, rare. There are reports from France, England, Austria, and America, even cases of poisoning of a whole family, but they are rare compared with that done with other drugs.

Accidental poisonings have occurred repeatedly by the substitution of potassium cyanide for a potassium ferrocyanide or chloride. Surely the most tragical case occurred in the practice of Arnold. A child died immediately after the ingestion of a dose of a mixture which contained potassium cyanide instead of potassium chloride. The druggist, with the intention of demonstrating the innocence of the preparation, emptied the bottle himself, and died on the spot, and Arnold, who tasted the mixture a little too freely, fell unconscious and died in six hours.

Though death is rapid, it is not instantaneous; in all cases there must elapse time for the poison to be absorbed into the blood. Preyer saw, even after the injection of 1 c. c. of 60-per-cent. prussic acid into the jugular vein, an interval of twenty-nine seconds before the occurrence of cramps, and an interval of ten or fifteen seconds even after the use of the pure acid. Cases of exceptional delay of absorption or osmosis have been recorded. Thus, in a case reported by Garson, symptoms did not appear for a quarter of an hour, the patient occupying the time meanwhile in writing. Various actions have been performed before the symptoms set in. Individuals have climbed stairs, for instance, crossed the street, held a conversation, and then fallen into sudden fatal collapse. An exquisite case was mentioned by Taylor. A woman who took 15 grammes of essence of almonds—which contains 2 grammes of the oil of almonds—went to a well, drew water, drank a large quantity, ascended two pairs of stairs, called to her children, descended one pair of stairs, then fell upon her bed and died in half an hour after taking the poison. Ignorance of these things has turned suspicion upon innocent persons who have subsequently administered food or drink.

Action.—Prussic acid, like oxalic acid, differs in its action from that of acids in general, as it is a substance which, according to Geppert, induces "an internal suffocation of the organs in the presence of an excess of oxygen" (v. Jaksch).

Prussic acid prevents the tissues from absorbing oxygen from the blood-corpuscles and from surrendering carbonic-acid gas in a medium free from it. It has been shown by experiments that less oxygen is absorbed and less carbonic acid produced than normally. This condition does not depend upon interference with the exchange of gases in the lungs or blood, for both organs have been found to act in a perfectly normal way. It can only be caused by an interference with the process of metabolism in the tissues, especially by a paresis of the histozymes, which induce metabolism. The diminution of the consumption of oxygen in the tissues may be at times so great that the blood may be returned from the tissues into the veins bright red, laden with its whole cargo of oxygen. Part, at least, of the intense and sudden interruption of the histochemical process is dependent upon this cause (v. Jaksch). When binoxide of hydrogen is brought into contact with prussic-acid blood it is not decomposed, as it usually is in water and oxygen, but it colours the blood brown, even in as small a quantity as 1 to 800,000, whereby the blood loses its absorption bands.

Hoppe-Seyler, Preyer, Schönbein, Gaethgens, and Hiller have shown that prussic acid does not destroy hæmoglobin, but enters with it into a chemical combination, cyanmethæmoglobin, and the crystals which may be obtained from this altered blood are of considerable constancy. The conclusion that prussic acid destroys the physiological function of the red blood-cells is thus confirmed.

Whether, or to what extent, the poison exer-

cises a direct effect upon the central nervous system (irritation with subsequent paralysis) remains undecided.

The convulsions which occur in the course of prussic-acid poisoning, and which resemble in some cases exquisite tetanus and in other cases have an epileptoid character, are considered by Preyer as the convulsions of suffocation, but are looked upon by Böhm and Knie as due to intense excitation of the convulsive centres in the brain and spinal cord. That the brain is affected is proved by the grave intoxication, up to abolition of consciousness, which occurs in man. But whether this effect is direct or not may not be asserted, as Krimer found that painting the brain and cord with prussic acid was attended with no intoxication, while Jones found that the application of prussic acid to the cord produced rapid poisoning. According to Funke, the motor nerves lose their irritability late and under direct application less rapidly than striated muscle, but the sensitive nerves lose their electromotor power.

Preyer believes that prussic acid depresses the respiratory central organs. That there are prussic-acid paralyses of the heart has long been known. Kreimer found that the direct application of it to the freshly exsected frog's and crab's heart in a few seconds brought about an arrest which could not be overcome by an electrical irritant. Where the acid was very dilute, the arrest was preceded by an increasing retardation of the pulse. Meyer, after exposure of the heart of the frog, introduced prussic acid into the mouth or into the wound, and observed temporary diastolic arrest, very marked retardation of the pulse, and finally cessation, while the paralyzed heart was distended with blood. Kölliker made this observation in poisoning with potassium cyanide, and ascribed the paralysis to the effect of the poison upon the muscle fibre, as he could not account for the enormous distention of the organ by a simple paralysis of the ganglia and nerves of the heart. The observation of Rossbach and Papilsky, that the great weakness of the heart's energy caused by prussic acid may be counteracted in the most extraordinary way by the subcutaneous use of atropine, is not without analogy, as, for instance, in the case of aconitine.

Prussic acid is probably excreted in the sweat and in the expired air, as they both have the odour of it. It has not been demonstrated in other secretions.

The fate of prussic acid in the organism is not established, but the odour of the breath and the exhalation from the skin point to partial elimination by the lungs and skin. Prussic acid has been demonstrated in unchanged form in the blood and brain, but the demonstration often fails in consequence of the decomposition and oxidation of prussic acid in the stomach, with the formation of formalic acid and ammonia. Kobert, in a case of poisoning, found hydrocyanic acid in the urine.

Prussic acid affects all classes of animals. Cold-blooded animals are less sensitive than warm-blooded, and succumb more slowly with gradual loss of motion. Birds are more sensitive than mammals; insects, crustacea, and molluscs are more resistant than vertebrates. Dogs quickly succumb after from 0·007 to 0·01 of a c. c. of prussic acid (10 per cent.). Prussic acid has no effect upon certain schizomycetes. The process of fermentation is not arrested, but is hindered, so long as the poison is present.

Pathology.—The symptoms and cause of poisoning with prussic acid vary according to the concentration and purity of the preparation. Poisoning with strong prussic acid runs its course in a few minutes, and is usually fatal in less than a quarter of an hour. "Death by prussic acid is like death by lightning. It occurs at once, or nearly so, or the patient recovers entirely" (Taylor). Hence there is not much opportunity for clinical history. The patient often, but not necessarily, falls with a cry, respiration is enormously increased and becomes irregular, and convulsions set in, or there is immediate collapse, with a few spasmodic respirations, and death by arrest of respiration, apparently in a moment.

The majority of cases, however, have a slower course, so that as many as four stages may often be distinguished. In the first there are vertigo, obscuration of vision, nausea, and a sense of tightness with palpitation of the heart—the prodromal stage. Hereupon the respiration is altered in a very characteristic way. Inspiration is short and deep; expiration, on the other hand, is long drawn and is followed by a long pause—the asthmatic stage. When consciousness has fully disappeared, violent convulsions set in—the convulsive stage. This stage is followed rapidly by a general paralysis, especially of respiration, and lastly of the heart—the paralytic stage. In the height of the action of the poison "the patient lies perfectly unconscious and insensible, with the eyes fixed and glistening, the pupils dilated and unaffected by light, the limbs flaccid, the skin cold and covered with clammy perspiration. The respiration is slow, deep, gasping, and occasionally heavy or sobbing. There is convulsive breathing at long intervals, and the patient appears dead in the intermittent period" (Taylor).

In a case under the observation of the writer life seemed to have ceased absolutely on three occasions, but showed itself again in manifest signs, once with obscure signs of returning consciousness. Then all at once, without apparent cause, the patient would relapse into stupor, convulsions, or apparent death.

Under a still smaller dose minutes may elapse—as much as a quarter of an hour—before any symptoms of poisoning show themselves. Hereupon set in headache, vertigo, nausea, sometimes vomiting, præcordial anxiety, and a tumbling gait. As a rule, grave changes of respiration show themselves soon. As stated, the frequency increases rapidly, then sinks, and the breathing becomes exceedingly irregular. The heart sounds become feeble, the pulse grows scarcely perceptible. The body disseminates an intense odour of prussic acid, especially by the breath. Hereupon ensue hallu-

cinations, delirium, and sometimes trismus or opisthotonos. The pupils are dilated, the eyeballs are prominent, and the skin, more or less cyanotic, is covered with a cold sweat. Now, generally, convulsions occur. The patient is somnolent and falls into stupor and coma, the discharges are evacuated involuntarily, the radial pulse ceases, and the breathing stops.

As a rule, the spasm affects most the muscles of the neck and mastication. The lower jaw is firmly closed, the lips and tongue are cyanotic. The sudden collapse with the cry that the English writers call the death shriek, and which has been compared to the epileptic-fit shriek, is not characteristic of prussic-acid poisoning, as the same thing occurs after poisoning by sulphuretted hydrogen and nicotine. But the conduct of the breathing is exceedingly characteristic, as the inspiration is short and the expiration which follows is unusually prolonged, up to entire cessation, with continuously increasing intervals of apparent death (Husemann).

Chronic poisoning, which was demonstrated experimentally by Koritschöner, and which occurs among artisans long or repeatedly exposed to the vapours of prussic acid, gilders, photographers, etc., shows itself in headache, vertigo, weariness, ringing in the ears, impeded respiration, sometimes even dyspnœa, palpitation, pain in the præcordial region, constriction of the throat, anorexia, nausea, and obstinate constipation. The pulse remains full, the skin is cool, and the face shows lividity. The breath is fetid. Sometimes symptoms show in the chronic form which are not especially characteristic of prussic-acid poisoning, such as retardation of the pulse, vomiting, salivation, acute pharyngeal catarrh, and albuminuria.

Cases of chronic poisoning are recorded by Taube, who studied the effects of the use of small doses of bitter-almond water upon a number of students at Greifswald. This observer found in these cases, after the use of the drug for from three to five days or more, catarrh—that is, coryza—with frontal pain, irritation, and other abnormal sensations, an alteration of secretion in the pharynx and larynx in certain cases, a feeling of oppression in the chest, cough, great weariness, insomnia, vertigo, syncope, distaste for life, sensitiveness to sound, and opposition to treatment.

In a case recorded by Koritschoner, in which poisoning occurred from small amounts of prussic acid taken in increasing quantities, there were observed, besides the altered secretion of the pharynx and larynx, ptyalism, retardation of the pulse, weariness, and in three or four days albuminuria. The reports of the older writers concerning workers in the trades with prussic-acid fumes mention as symptoms vertigo, ringing in the ears, headache, dysphagia, palpitation, dyspnœa, and convulsions, and referred these symptoms rather to light acute poisoning than to chronic intoxication. Preyer showed that long work with prussic acid increased the sensitiveness to the poison.

Martius observed among gilders working with argentine, a prussic-acid preparation, cases marked by convulsive cough and nasal catarrh, with vomiting, headache, and weariness. Long-continued marasmus occurs in some cases after the inhalation of the vapour. Thus, Martin reported in the case of a girl who had to apply silver to certain pieces of bric-a-brac, weakness of the muscles, which lasted longer than a year, and Mittenzweig reported the case of a physician who made an autopsy upon a labouring man poisoned by enormous doses of potassium cyanide, whose body developed the odour of prussic acid and ammonia so intense as to be benumbing, who suffered irritation of the throat and later collapse of strength with attacks of syncope, heart failure, headache, and insomnia, which ceased only after a five months' stay at the sea coast.

Morbid Anatomy.—In death from prussic acid the body is usually found lying calm and tranquil, without any mark of struggle or convulsions. It shows suggillations of a bright-red colour. This coloration is especially marked in the mucous membrane of the stomach and in neighbouring organs. Sometimes the liver is found in a state of parenchymatous, even beginning fatty, degeneration. The coloration is characteristic, and is caused by the formation of prussic-acid (cyan) methæmoglobin, which is distinguished from normal brownish-red methæmoglobin by its bright-red colour. The blood is always fluid. The brain is, with many exceptions, hyperæmic. The lungs are sometimes œdematous and emphysematous, especially at the borders. Ecchymoses are found under the pleura and other serous membranes. In poisoning with potassium cyanide, an alkali which ranks next in intensity to caustic potash itself, the mucous membrane of the stomach may show serious changes. But the dissemination of the characteristic odour in the various organs is the most important circumstance.

In the arterial blood the carbonic acid may be reduced to a third of the normal, and in the venous blood it may be reduced below the normal contents of arterial blood. The bright-red colour of all the blood finds its explanation in this way. The former view of the firm union of oxygen has been surrendered, because, on the one hand, the bright-red blood during poisoning becomes darker again, and, on the other, oxygen is easily withdrawn from the blood under the inhalation of hydrogen. The inhibition of oxidation in prussic-acid poisoning is supported by the fact demonstrated by Zillesen, that large quantities of lactic acid and sugar are found in the blood of poisoned animals.

Diagnosis.—The diagnosis rests upon the rapid course, above all things upon the odour of prussic acid. In cases of suicide or accident the phial or vessel from which the poison has been taken is usually found near the patient, though where the symptoms are delayed it may have been thrown away or concealed. The larger the dose, the more intense is the odour. In one case a railroad inspector killed himself and his wife, who was six months pregnant, on account of financial troubles. They obtained the cyanide from the druggist

under the pretext of renewing gilding on a carriage. The man was found seated quietly in the corner of a sofa; the woman had fallen from the sofa and was found lying on the right side. The odour of the cyanide was so intense that people who first entered the room were taken sick, and the medical men who made the autopsy later found the odour very disagreeable, notwithstanding the fact that the windows had been kept open meanwhile for a long time. In one case a quantity as small as 0·054 of a gramme was appreciated after ninety hours. The odour can be recognised usually three, four, or five days, sometimes as long as from seven to twelve days. On the other hand, there are cases, especially where death has been produced by prussic acid itself, where the odour is lost in twenty-four hours. After the body is opened the odour disappears quickly, while that of nitrobenzol, which simulates it, remains intense much longer.

The odours of prussic acid and the allied oils may be distinguished when comparisons can be made at the same time. The oil of bitter almonds has the peculiar smell of bitter almonds as developed by the rubbing of them. The odour is due to the ethereal oil, which is volatilized. This odour is, of those of all three substances, the most agreeable and finest. That of nitrobenzol is near to it, but is not so agreeable. If a drop of each substance is rubbed between the thumb and finger there is perceived in the case of nitrobenzol an odour which suggests benzine. Prussic acid has its specific odour, which can be compared to nothing else. It is intense and sharp, and persists a long time in the nasal cavities, while the two other fluids have not this property. Where the poisoning is not intense, the symptoms may be mistaken for those which follow poisoning by nitrobenzol.

But a series of symptoms distinguishes the condition. Poisoning by nitrobenzol occurs, as a rule, several hours after its ingestion. It leads to the most extreme cyanotic coloration of the skin, which continues for days. The nervous symptoms, which may be the same as those of prussic-acid poisoning—to wit, trismus, convulsions, and coma—occur paroxysmally.

Poisoning with nitrobenzol is distinguished by the slow development of the symptoms up to coma. In nitrobenzol poisoning the pupils are dilated, but are never entirely insensitive to light. Finally, poisoning by nitrobenzol shows much less intense lividity of the surface of the body.

The struggling, spasmodic respiration, during which the odour of prussic acid is perceived in the breath, occurs in paroxysms of long intervals, while the patient in the mean time appears to be in a state of apparent death, and the persistence of life is shown only by the continuance of the faintest possible pulse. This, next to the odour of the breath, is the most characteristic feature of prussic-acid poisoning.

Prognosis.—The prognosis is always unfavourable, but becomes more favourable with the lapse of time. Most patients succumb rapidly, but some individuals recover after twenty-four hours, and rapidly and entirely, without sequelæ.

Death usually sets in in from two to five or ten minutes, after a smaller dose in from half an hour to an hour, according to age, strength, previous health, condition of the stomach, etc. Seven autopsies in the Biçêtre, in Paris, were made upon patients who had taken about the same dose of nearly pure prussic acid, 0·468 of a gramme, and who had died at periods ranging from fifteen to twenty minutes, the last in forty-five minutes. Cases where individuals have lived for hours are rare. The chances of recovery are much increased if the individual survives the first hour and consciousness returns. Remissions have been observed, but, as stated, they are very rare.

Recovery is rapid and perfect, in wonderful contrast, therefore, to the intensity of the symptoms. It is sometimes announced by vomiting. There is occasionally left a feeling of weariness, vertigo, and tightness in the breast, exceptionally as long as from eight to fourteen days (v. Jaksch).

Tests.—Prussic acid is best demonstrated on autopsy by its characteristic odour. This odour is found purest in the cavities of the skull. It is advisable, therefore, to open the skull first, before the particular odours of other cavities of the body may make confusion. Though mixed with oil and put into a vessel covered with a membrane, prussic acid is so volatile as to disappear rapidly. Perfectly pure alcohol should therefore be poured over the body, and vessels containing parts or preparations supposed to contain it must be hermetically sealed. The contents of the stomach or parts of the body should be lightly acidified and distilled under gentle heat, to liberate the characteristic odour. In the absence of this odour there is no gross evidence of the presence of prussic acid. It may be present in too small quantities, or may be united with the blood as cyanmethæmoglobin, and be odourless. Proof may then be furnished only by chemical examination. There are many very delicate tests. The two best known consist in the formation of the blue ferrocyanide of iron (Berlin blue), and the formation of the blood-red sulphocyanide of iron. A third very delicate test consists in the formation of the cyanmethæmoglobin. A fourth extremely delicate test, but not always reliable, depends upon the discoloration of a solution of the blue iodide of starch by traces of prussic acid with the formation of iodcyanogen (v. Jaksch).

Sulphocyanate Test (Liebig, 1847).—Place a portion of the liquid in a porcelain capsule; add a few drops of a dilute solution of sodic hydrate and a few drops of a yellow solution of ammonium sulphydrate; evaporate to dryness over the water bath; add water; acidulate with hydrochloric acid; and then add two or three drops of solution of ferric chloride. If the liquid contains hydrocyanic acid it will be converted by this treatment into sulphocyanate of sodium, which with the ferric salt gives a fine red colour. This is the most delicate of the tests for hydrocyanic acid, a distinct

reaction being obtained with a solution of 1 to 4,000,000 (Linck and Möckel).

The following tests for prussic acid in the vomited matter are furnished by von Jaksch: The matter, after the addition of small quantities of tartaric acid, is subjected to distillation. The prussic acid passes over into the still. In order that this demonstration may be conclusive of poisoning, it must previously have been shown that there are not possible double cyanide salts in the vomited matter, for instance, ferrocyanide or ferricyanide of potassium. This test is best made with a solution of chloride of iron and iron sulphate. Ferrocyanate of potassium furnishes with the latter reagent a white, nearly light-blue, deposit, but with the chloride of iron a dark-brown colour. If both these bodies are present, the procedure must be, according to Jaquemin, as follows: The fluid acidified with sulphuric acid is subjected to an excess of carbonate of calcium. From the ferrocyanide or ferricyanide of potassium the corresponding salts of calcium are formed, and the prussic acid is detected in the distillate as follows: 1. A few cubic centimetres of the distilled matter are rendered alkaline with potash lye. To this preparation are added a few drops of a freshly prepared copper-sulphate solution. The solution is then heated a short time and held a minute at the boiling point (Ludwig), whereupon hydrochloric acid is added to the cold solution up to the point where the reaction becomes markedly acid; thus is produced a blue fluid from which are deposited, after long standing, blue flakes of Berlin blue. 2. To a few drops of the distillate is added a solution of yellow ammonium sulphate containing yellow sulphide of ammonium. The preparation is boiled until the fluid loses its yellow colour. After cooling there is added solution of the chloride of iron and hydrochloric acid. The mixture shows in the presence of prussic acid a red colour (sulphocyanide of iron). According to E. Ludwig, the test may be executed as follows: The yellow sulphide of ammonium is added in excess, after the addition of a drop of potash lye, is evaporated to dryness, is put into water, and has added to it nitric acid, and the filtrate is tested with a solution of the chloride of iron. A bluish-red colour shows itself at once. 3. A further very valuable reaction is given by Volkmann. To the fluid to be tested are added a few drops of a solution of potassium nitrate, from 2 to 4 drops of a solution of chloride of iron, and dilute sulphuric acid, until the yellowish-brown colour formed at the start passes over into the bright yellow of the basic salt of the oxide of iron. The solution is boiled and cooled, ammonia is added, the solution is filtered, and to it is added a colourless solution of sulphide of ammonium. In the presence of the least prussic acid there is shown a bluish-green colour; in the presence of large quantities a beautiful violet-red. Volkmann distinguished this test as the nitroprussic reaction.

A quantitative test is made by the addition to the distillate (which is freely acidified with nitric acid) of nitrate of silver. The cyanide of silver is precipitated. This salt is dried and weighed. One hundred and thirty-four parts of the cyanide of silver correspond to 27 parts by weight of pure prussic acid. It has been objected to the quantitative test that prussic acid may develop under decomposition, and may pass over into the distillate. This is, however, a pure hypothesis, as no one has ever demonstrated prussic acid as a product of decomposition. Prussic acid may be detected in the expired air by the guaiac-copper tests. Strips of filtering paper are saturated with the tincture of guaiac (resin 3 to 4 per cent.), and after evaporation of the alcohol are wet with a solution of copper vitriol. A piece of filtering paper thus prepared is turned blue under the faintest trace of the vapour of prussic acid, therefore by that in the air exhaled from the lungs (Husemann). Unfortunately, this test is somewhat unreliable, since the same reaction is shown with ammonia, traces of which are nearly always to be found in the mouth.

A quick test for the detection of prussic acid in vapour is made by holding over the liquid a watch glass moistened in the centre with a solution of nitrate of silver, whereby an opaque white film is developed by the formation of the cyanide of silver.

The most sensitive reaction for the detection of prussic acid in the breath consists in the blueing of a piece of filtering paper which has been saturated with tincture of guaiac containing from 3 to 4 per cent. of resin, and after evaporation of the alcohol steeped in a solution of copper vitriol.

Warming with a little caustic potash and a few drops of a watery solution of picric acid changes the colour of a prussic-acid fluid to a blood-red.

A solution of starch which has been rendered blue by tincture of iodine or a solution of iodine with potassium iodide is, after the addition of prussic acid, decolourized by the formation of cyanide of iodine.

The Methæmoglobin Test.—The conduct of methæmoglobin in the presence of hydrocyanic acid has lately been established by Kobert as distinctly characteristic. This process permits of the recognition of the presence of prussic acid during life, and is the most reliable of all the tests. The addition of prussic acid to a 1- to 4-per-cent. solution of methæmoglobin which has been prepared by the addition of potassium chlorate to a solution of blood gives to the brown mixture a beautiful red colour, while the absorption bands of the methæmoglobin in the red disappear with the formation of a red cyanide combination whose spectrum does not show these bands.

In the demonstration of poisoning Kobert advises the withdrawal of a few drops of blood at the same time from the supposed subject of poisoning and from a healthy person. The blood should be allowed to drop into a test tube filled with distilled water, both solutions being diluted to the same degree of red colour. To both solutions should now be added cautiously a solution of potassium chlorate, drop by drop. The normal blood becomes brown on shaking and shows the methæmoglobin bands; the poisoned blood remains red (unless

too little prussic acid has been added) and shows the spectrum of cyanmethæmoglobin.

For post-mortem examinations Kobert recommends two uniformly large, white, square medicine bottles of the capacity of from 5 to 30 c. c. Both glasses are to be filled with sterilized—that is, boiled—well-water, and a few drops of blood are to be added, the blood being taken in the one case from a healthy and in the other from the poisoned body. The vessels, filled to the brim with blood free of oxygen, are to be thoroughly corked and the corks are to be hermetically sealed with tallow or with paraffin. The blood then shows in both vessels, in consequence of the oxygen which has penetrated during the preparation, a spectrum of oxyhæmoglobin. But if the experiments are conducted at room temperature a difference is noticed on the following day, in that the normal blood has become venous, displaying the spectrum of hæmoglobin, while the prussic-acid blood, though kept for several days, even weeks, remains of a bright-red colour and shows the spectrum of oxyhæmoglobin. The combination which results from the effect of prussic acid upon methæmoglobin, whether it is kept in an alkaline, an acid, or a neutral solution, maintains a brilliant red colour and shows in the spectrum a feeble band, not sharply circumscribed like that of reduced hæmoglobin; but the violet and blue are much more distinct, the red being less absorbed than in a similarly concentrated solution of reduced hæmoglobin. On agitation with air, the spectrum does not change into that of oxyhæmoglobin.

The spectroscopic proof is indispensable in the test for methæmoglobin, because a number of other substances, such as dilute solutions of alkalies, especially of alkaline earths, and, further, of alkaline carbonates and alkaline nitrates, give a red colour to methæmoglobin, with the spectrum of the alkaline methæmoglobin. On account of the resemblance of the spectrum produced by prussic acid in a solution of methæmoglobin to that of hæmoglobin, it is necessary to agitate the fluid with air to show that oxyhæmoglobin is not formed.

Besides methæmoglobin, hæmatin or hæmin, in substance or solution, may be used in the demonstration of prussic acid (Szigati). For this purpose the hæmin crystals are spread in a thin layer on a white ground. They are then touched with a drop of a 1-per-cent. potash solution, which develops a green spot. When the spot is dry the suspected distillate is dropped upon it and it is changed in the presence of prussic acid to a red colour. This red colour, examined by transmitted light, shows the spectroscopic picture which is obtained in the treatment of methæmoglobin with prussic acid. If the distillate is mixed with a solution of caustic potash, it is not necessary to touch the hæmin with the lye. To make the test in a solution pure hæmatin or hæmin is dissolved in a very dilute potash solution; the green colour is changed to red if the fluid contains any prussic acid (Husemann).

So, notwithstanding its extreme subtelness and evanescence, and the great rapidity of its action, almost without lesion, prussic acid can not escape the keen scent of the chemist or elude his more delicate analysis. Notwithstanding the facts, also, that prussic acid is so easily decomposed, and that even in sterilized solutions outside the body it is readily changed into formalic acid and ammonia, a change which occurs still easier in contact with organic substances, the acid may be demonstrated even after the lapse of several days, and in one case it was shown by Reichardt after the lapse of four weeks. In fact, it has been disclosed at almost any period after its introduction into the body. Kramer discovered prussic acid in the blood of an animal which had died in thirty-six seconds after its administration. Ramus found it in the stomach by distillation, in the entire absence of odour, seven days after death. McKinley detected it doubtfully by the odour but distinctly by three tests seventeen days after death, and Taylor detected prussic acid when mixed in small quantity with porter and kept in a closed vessel after the lapse of twelve months.

With evidence of a negative character the chemist has also been able to exculpate innocent parties. Thus in the Cause Célèbre Hériter, at Cambèry, in 1841, the prisoner was sentenced and would have been executed had not Orfila shown that the death of the deceased was due to apoplexy and not to prussic acid. It must be remembered that very minute quantities of prussic acid may reach the body in the food and drink, or in parts of plants which may contain it. Regard must be had to these things in the individual case. It should be known also that prussic-acid poisonings complicated with poisoning by arsenic, opium, etc., have been put upon record.

Treatment.—The treatment consists in a removal of the poison by irrigation of the stomach, by provoking vomiting, and in the use of agents to secure direct and indirect excitation of the central nervous system (excitants, cutaneous irritants, faradization), with the practice of artificial respiration. If the physician is called sufficiently early, it is best to wash out the stomach thoroughly until all odour of hydrocyanic acid is lost. The addition of the peroxide of hydrogen is recommended, as it converts prussic acid into the relatively innocuous oxamide. Other remedies have been recommended as follows: Atropine in subcutaneous injection, 0·001 to 0·01; the hydrated oxide of iron, magnesia, and ammonia, but none of these things are of any real value in practice.

Antidotes.—Antal, of Buda-Pesth, recommends cobaltous nitrate (cobaltum nitricum oxydulatum) injected subcutaneously, 20 to 30 c. c. of a 0·5- to 1-per-cent. solution, and internally a glassful of the 0·5-per-cent. solution. This salt of cobalt is eliminated as rapidly as it is absorbed. If the patient is unconscious, the preparation may be introduced through a stomach-tube.

The antidotal action of different substances is based upon the conversion of the prussic acid into an insoluble cyanide of iron or of magnesium. Thus, Duflos recommended a preparation under the name of *ferrum sulphu-*

ratum hydratum cum magnesia. This preparation, which was obtained by the addition of a solution of 6 parts of crystallized iron vitriol to a mixture of 4 parts of a solution of caustic ammonia (0·97 specific gravity) and 6 parts of sulphuretted hydrogen (ammonium sulphide), was to be kept ready in hermetically sealed phials. Two parts of *magnesia usta* were to be added before its use as an antidote.

Messrs. T. and H. Smith, of Edinburgh, furnish the following formula for an antidote which will neutralize prussic acid in the stomach: Administer 2 drachms of magnesia made into a cream with water, and follow this up with 16 minims of the solution of perchloride of calcium and 12½ grains of ferrous sulphate in solution in water. These quantities will neutralize 100 grains of the dilute acid. The preparation of the Smiths secures the administration of the iron *in statu nascendi.* The excess of magnesia in both antidotes contributes to neutralize the acidity of the gastric juice.

Preyer, from his experiments on animals, recommended atropine as an antidote, but Böhm and Knie got worse results from atropine than from artificial respiration. In one case Wichmann secured some improvement by two injections of atropine, 1 milligramme; nevertheless, death occurred thirteen hours later, with sudden paralysis of respiration.

The use of chlorine and ammonium, which were for a long time regarded as antidotes, is not only irrational, but dangerous, because the combinations which they form with the cyanides are but little less poisonous than prussic acid.

The most effective treatment, according to Husemann, consists in the application of cold douches to the head and along the spine, from a height of from one to two feet, while the patient is in a warm bath. If this means fails, artificial respiration should be resorted to. The administration of oxygen furnishes no real help. But few cases of successful treatment with artificial respiration have been recorded.

On account of the chemical changes produced by prussic acid, transfusion with venesection might appear rational, and, though no experiments are recorded in this direction, the process may be resorted to as a *refugium ultimatum* in desperate cases (Husemann).

Kóssa, of Hungary, in 1893, at the instigation of Krohl and Kobert, made experiments with potassium permanganate which resulted in the discovery that this agent could render innocuous in the body ten times the fatal dose of potassium cyanide, but, as these experiments were made immediately after the ingestion of the poison, they may as well have been made in the test tube outside of the body, as they demonstrated only that prussic acid was rapidly oxidized by the potassium permanganate. Whether this suggestion can ever be utilized in practice is doubtful, as the physician is hardly ever called early enough. The suggestion is to administer fifty times as much permanganate by weight as the potassium cyanide taken. The patient should take as rapidly as possible ⅓ to ½ a pint of a 0·3- to 0·5-per-cent. solution of the potassium permanganate.

Cold affusions to the head and spine constitute the most powerful stimulus of the respiratory centres; hot baths may be used with cold affusions to heighten their effect. To combat collapse of the heart, the oil of camphor, or camphor and ether (1 to 10), should be injected subcutaneously, and resort may be had to the transfusion of blood or preferably to the subcutaneous infusion (hypodermoclysis) of the physiological salt solution 0·6 per cent.

James T. Whittaker.

HYDROGEN DIOXIDE, or *peroxide*, or *oxygenated water*, is, when pure and undiluted, a syrupy liquid of a faint chlorous odour, and has the formula H_2O_2. It readily decomposes into water and oxygen, and when confined may yield sufficient of the latter to cause disastrous explosions, even when the solution has been freely diluted. In its undiluted state it is rarely met with. *Aqua hydrogenii dioxidi* (U. S. Ph.), which contains 3 per cent. of the dioxide and a trifling amount of sulphuric acid, acts as a preservative. It is the form most suitable for general use. A number of unofficial preparations are met with which do not vary greatly in strength from the official solution, but usually contain small quantities of hydrochloric acid. Hydrogen dioxide is used largely in the arts as a bleaching agent, and a few drops of the official solution to the water in which photographic negatives are washed will remove the last traces of the hyposulphite of sodium used in fixing them. As it parts readily with its oxygen, it would seem to be a valuable oxidizing *disinfectant*, but the rapidity with which decomposition occurs and its relatively high cost as compared with that of mercuric chloride, etc., prevent its extended employment. When, however, the expense does not stand in the way, it may be used as a household deodorizer, provided it is not allowed to come in contact with metals or coloured fabrics.

Although upon its first introduction into medicine good results were alleged for it in the treatment of *glycosuria*, it is really without much effect upon the economy, as it parts with its oxygen long before absorption can possibly occur, and it is more than probable that there is rapid combination of the oxygen with the organic matters contained in the stomach. It may be made use of for the preparation of small amounts of oxygen, in cases of emergency, by adding to it a solution of potassium permanganate. Considerable oxygen will be evolved, a portion of which will be obtained from the permanganate. In conducting this process the receptacles employed must be of glass, and care must be taken to provide a sufficient outlet for the gas, which is often given off with great rapidity and violence. Although distinctly inferior to mercuric chloride as a disinfectant and germicide, the entire freedom of hydrogen dioxide from poisonous properties renders it of great value in the treatment of *unhealthy suppurating surfaces, abscesses*, etc. Its first effect, when applied under such conditions, is to cause an evolution of gas; subsequently a slight coagulation takes place, so that a protective coating is formed. At the same time the pus-corpuscles are disintegrated

and broken up. *Chancroid* and *chancres* are said by some to heal more rapidly and to be accompanied by less extensive destruction of tissue when treated with this substance than when other methods are followed. Like nearly every other official fluid preparation, it has been recommended as an injection in *gonorrhœa*, but, as plain water often is entirely efficacious, its true value is somewhat problematical. It may be injected into deep-seated abscesses and sinuses with entire safety except in cases of thin-walled cavities, the walls of which might be ruptured unless a free outlet was afforded for the gas given off. In the treatment of *superficial ulcerations*, etc., it may be applied with a swab, and cloths wet in it may be allowed to remain applied continuously. Some metals are attacked by it and others not, but in all cases it is safe to employ glass or rubber syringes, etc., in preference to those of metal. To disinfect and deodorize the hands it is entirely appropriate. In *diphtheria*, *scarlet fever*, *amygdalitis*, and all conditions in which there are active inflammatory processes in the upper air-passages, it may be used to good advantage, being applied with a swab or by the means of an atomizer. Solutions of from 10 to 15 per cent. are largely employed to give a lighter hue to dark-coloured hair, and whenever there would seem to be any good reasons for effecting such a change it is probably better than anything else. Weaker solutions may be employed, especially in blondes, to give a uniform tint to hair which is streaked with several shades of the same colour.

[In an editorial in the *Dental Cosmos* for April, 1895, the writer says that an interesting adaptation of the cataphoric method is in bleaching *discoloured teeth* as follows: The tooth to be bleached is prepared and desiccated, with the rubber dam adjusted in the same way as in ordinary bleaching operations. A pledget of cotton saturated with a 25-per-cent. solution of pyrozone is introduced into the pulp chamber, the canal, and the cavity of decay, and the positive pole of a battery of low tension, furnished with a needle-like platinum electrode, is put in contact with the pyrozone. The negative electrode may be held in the patient's hands, or when mounted with a suitable point may be applied to the outer enamel surface, and the current short-circuited through the tooth structure in any desired direction. Decomposition of the pyrozone follows at once the completion of the circuit, and bleaching rapidly ensues. By applying the negative electrode to the enamel surface the bleaching effect is produced immediately under the point of contact, and can thus be brought to bear on any area of local discoloration at will. The treatment of pulpless teeth in the manner indicated, says the writer, is an advance over former methods, and one of more significance than may appear from a casual observation.]

Russell H. Nevins.

HYDROGEN SULPHIDE.—See under Sulphur.

HYDRONAPHTHOL. — Beta-naphthol. See under Naphthol.

HYDROQUININE is a natural alkaloid occurring in cinchona. Its properties closely resemble those of quinine, from which it varies chemically in containing two more atoms of hydrogen. Its formula is $C_{20}H_{26}N_2O_2$. Hydroquinine was first isolated by Hesse, who found it in the mother-liquors from which quinine sulphate had been crystallized, and subsequently obtained it from commercial quinine sulphate in small amount. The drug has had a limited employment in medicine as a substitute for quinine, the therapeutic properties of which its own resemble. It has been thought an efficient *antipyretic*, but it is practically not used at the present time save unintentionally, when it contaminates quinine. Seifert, who experimented with hydroquinine, compared it with salicylic acid, and considered it rather superior to that remedy in reducing febrile temperature. With the fall of temperature it produces there also occur circulatory sedation and free diaphoresis. The continued administration of hydroquinine does not appear to be harmful. It is freely soluble in alcohol and in ether.—Henry A. Griffin.

HYDROQUINONE, the *Hydrochinon* of the Germans, $C_6H_4.O_2H_2$, isomeric with resorcin, is obtained by the oxidation of arbutin and in other ways. It has been used as an *antipyretic*, as an *analgetic*, and as an *internal antiseptic* in daily amounts of from 4 to 7 grains in divided doses.

HYDROTHERAPEUTICS.—See Hydriatics.

HYDROXYLAMINE HYDROCHLORIDE, $NH_2.OH.HCl$, forms colourless crystals readily soluble in water, in alcohol, and in glycerin. It has been recommended in the topical treatment of *lupus*, *pityriasis*, *psoriasis*, and *parasitic skin diseases*, in a solution of the strength of 1 to 1,000. It has the advantage over pyrogallic acid and chrysarobin that it does not stain.

HYOSCINE.—At meetings of the German Chemical Society held on April 30 and July 26, 1880 (*Ber. d. dtsch. chem. Gesellschaft*, vol. xiii, pp. 909 and 1549), Professor A. Ladenburg reported some results of his researches among mydriatic alkaloids, particularly those of *Hyoscyamus niger*. At that time this plant was known to have two alkaloids—viz., crystallized and amorphous hyoscyamine. He derived a new alkaloid, hyoscine, from the latter, and it is not, as some suppose (Hoehn and Reichardt), to be obtained from crystalline hyoscyamine. He found that hyoscine, hyoscyamine, and atropine were actually isomeric, the formula for each being $C_{17}H_{23}NO_3$, and, furthermore, that each was separable into trophic acid, $C_9H_{10}O_3$, and tropine, or pseudo-tropine, $C_8H_{15}NO_3$. He also converted hyoscyamine into atropine and atropine into hyoscyamine in his laboratory, though he has not thus far been able to transform hyoscine into either of the other mydriatics.

It was put in use at once by some of the German physicians, and found by them to be therapeutically allied to hyoscyamine. It is a *mydriatic*, a *hypnotic*, and a *cardiac*, *respira-*

tory, and *spinal depressant.* It was first used in insanity in this country by the present writer, who, with Dr. Langdon, employed it in sixty cases of insanity of all kinds in the Hudson River State Hospital for the Insane (*Med. Record*, Sept. 19, 1885). Our conclusions as to the value of the drug—since corroborated by others, who, both at home and abroad, have used it extensively—are briefly as follows:

Hyoscine is not a real hypnotic, such as chloral, opium, and the bromides, although it disposes to sleep by causing muscular relaxation and a feeling of weariness, and does in large doses produce stupor. The sleep apparently caused by it is of short duration, and is easily broken. It should never be given by the mouth with a view of producing sleep, but only hypodermically. Its continued use is not advisable. Constitutional effects appear in some cases sooner and more severely than in others. The respirations are made shallower but not diminished in number (any more than by natural sleep). The pulse is often considerably reduced, sometimes increased in frequency, and usually made very variable. It may reduce or increase arterial tension. The face usually flushes and the extremities become cold. There is dilatation of the pupils with loss of accommodation. There are, further, dryness of the throat and mouth, dizziness, and, in many cases, anorexia and nausea, in some cases vomiting and diarrhœa. In a few cases there is a sensation of heat and itching of the skin. The severer effects are muscular tremor, unsteadiness of gait, delirium, and stupor. It seems in one or two cases to have increased erotism. In *insanity*, as a rule, it increased excitement by continued use. It made melancholiacs worse. It was no improvement on chloral and hyoscyamus in chronic mania, dementia, and general paresis. It was of no value in epilepsy.

In poisoning by hyoscine we observe symptoms similar to those of poisoning by hyoscyamine or atropine, such as variable pulse, flushed face, shallow respirations, dilated pupils, dryness of the throat and mouth, nausea and vomiting, tremor, unsteadiness, muscular weakness, delirium, and stupor. The treatment of hyoscine poisoning should consist in the use of stimulants and coffee. Caffeine and whisky may be injected subcutaneously. Artificial respiration should be resorted to. Attempts to arouse the patient from stupor may be made by means of the faradaic or galvanic battery and by flicking with a wet towel. Occasionally it may be advantageous to make cautious use of physostigma.

It was first used in *paralysis agitans* by me (*N. Y. Med. Jour.*, Oct. 11, 1890), and I found it very efficacious in diminishing the tremor.

The dose is the same as that of hyoscyamine and that of duboisine. It is safe to begin with from $\frac{1}{100}$ to $\frac{1}{60}$ of a grain, but much larger doses may be used.

[The hydrobromide, *hyoscinæ hydrobromas* (U. S. Ph.), *hyoscinum hydrobromicum* (Ger. Ph.), is the compound used in medicine.]

FREDERICK PETERSON.

HYOSCYAMINE is a white crystallizable alkaloid obtained from *Hyoscyamus niger.* It also occurs in *Datura Stramonium.* Its formula is the same as that of atropine, $C_{17}H_{23}NO_3$. It is also isomeric with duboisine obtained from *Duboisia myoporoides.* It has a bitter and acid taste and a neutral reaction. Usually the sulphate, *hyoscyaminæ sulphas* (U. S. Ph.), is employed medicinally, but the hydrobromide, *hyoscyaminæ hydrobromas* (U. S. Ph.), also is used. It is very soluble in water and in alcohol. The dose is from $\frac{1}{60}$ to 1 grain. It is used as a *sedative to the nervous system.* It is more often employed in *insanity* than its isomeric alkaloids, atropine, hyoscine, and duboisine, are. As an adjunct to purgatives it diminishes *griping.* It lessens *spasm* and allays *vesical pain* and *irritation.* Its physiological action is similar to that of atropine and that of daturine. It dilates the pupils, causes dryness of the mouth and fauces, and produces headache. Large doses produce difficulty of swallowing, rapid pulse, convulsions, paralysis, delirium, coma, and death. The heart's action is sometimes slowed and sometimes quickened by the drug. Respiration is first quickened and then slowed. It diminishes all the secretions, though the urine is sometimes increased.—FREDERICK PETERSON.

HYOSCYAMUS (U. S. Ph.), *hyoscyami folia* (Br. Ph.), *herba hyoscyami* (Ger. Ph.).—The leaves of *Hyoscyamus niger.* Henbane is the vulgar name of the plant, which is naturalized in the United States. It is an annual of the family *Solanaceæ.* The fresh herb has a rank, heavy, sickening, unpleasant odour, which disappears on drying.

The qualities of hyoscyamus depend upon its volatile alkaloid, *hyoscyamine* (*q. v.*), in combination in the plant with malic acid.

The name hyoscyamus means literally hog-bean, and the fact is that swine and some other domestic animals feed on it with impunity. It is poisonous to dogs, deer, rabbits, and fowl.

In its action on man henbane is analogous to stramonium and belladonna in many respects, though milder. Children can endure a larger dose than adults. As the result of taking poisonous doses (the sizes of which are very variable in different people), there are dilatation of the pupil, fulness of the head, giddiness, delirium with hallucinations, slowness or frequency of the pulse, extreme dryness of the throat and fauces, dysphagia, muscular debility, coma-vigil or coma, and death. The drug only occasionally brings on a scarlatinoid eruption like that of belladonna.

The chief use of hyoscyamus is as a *sedative to the nervous system.* It is frequently given in *spasmodic conditions*, to allay *vesical pain* and *irritation*, to lessen the *griping* of purgative medicines, and to relieve *cough.* In excited nervous conditions it is usual to employ its alkaloid, hyoscyamine, but often the tincture or the fluid extract is made use of in this country in asylum practice. In *insanity* its chief value is in certain cases of acute or chronic *maniacal excitement.* It should never be employed in melancholia, general paresis, epileptic insanity, or quiet forms. It should never be used as a hypnotic merely, because we have much better

soporifics at our disposition. The drug has some anodyne power, and hence its use in *griping pains* and occasionally in *neuralgias*.

The dose of hyoscyamus in substance is from 5 to 20 grains; that of the extract, *extractum hyoscyami* (U. S. Ph., Br. Ph., Ger. Ph.), is from 1 to 3 grains; that of the tincture, *tinctura hyoscyami* (U. S. Ph., Br. Ph.), is from ½ to 1 fl. drachm; that of the fluid extract, *extractum hyoscyami fluidum* (U. S. Ph.), is 5 minims; and that of the expressed juice, *succus conii* (Br. Ph.), is from ½ to 1 fl. drachm.—Frederick Peterson.

HYPNAL.—This is a mixture of 45 parts of chloral hydrate and 55 of antipyrine. It is readily soluble in water. It is employed as a *hypnotic* and is thought to be more efficient than chloral alone, especially in *insomnia with pain*. The dose is 15 grains.

HYPNONE.—See Acetophenone.

HYPNOTICS are medicinal agents which may be employed to produce sleep. In this wide sense the term would include the narcotics and the general anæsthetics, but it is usually restricted to those agents which, in the doses necessary to cause sleep, do not disturb the normal relationship of the mental faculties to the external world (Brunton). Another definition of hypnotics is that they produce sleep without suspending the consciousness of pain, narcotics doing both. Hypnotics may properly be subdivided into:

(*a*) *Indirect Hypnotics*, which induce sleep by removing or suppressing any cause (not mental) interfering therewith. Such are antipyrine, phenacetine, and other non-narcotic analgetics, acting against pain; strychnine and other respiratory stimulants, relieving pulmonary congestion and dyspnœa; hydrocyanic acid and other pulmonary sedatives, relieving cough; conium, gelsemium, and other motor depressants, restraining excessive motor activity; and ergot, digitalis, and other vascular and cardiac tonics, antagonizing cerebral hyperæmia and regulating the cardiac action.

(*b*) *Pure Hypnotics*, which directly induce a sleep closely resembling the normal, without causing narcotic or other dangerous cerebral symptoms. Such are the bromides, paraldehyde, sulphonal, trional, tetronal, urethane, chloralamide, etc.; but this list is constantly growing smaller as experience reveals toxic powers in the action of its members.

(*c*) *Narco-hypnotics*, which induce sleep by direct depression of the cerebral functions and in larger doses are narcotic, suspending the consciousness of pain and producing coma. (See Narcotics.) These include opium and its narcotic alkaloids, morphine, codeine, etc.; hyoscyamus and its alkaloids, especially hyoscine; also duboisine and various plants of the *Solanaceæ* which are more feebly hypnotic than hyoscyamus; alcohol, amylene hydrate, chloral hydrate, cannabis indica, etc.

The pure hypnotics and the narco-hypnotics are members of the materia medica class styled cerebral depressants.

Theory of Sleep and Hypnosis.—The oldest received theory of sleep ascribed it to passive congestion of the brain, as in coma; but this was upset by Dunham's observations on trephined dogs (1861), Hammond's and Mitchell's experiments (1866), and those of Mosso (1881), upon which was based the doctrine of cerebral anæmia as the immediate cause of sleep. Under this latter view the action of hypnotics was ascribed to vaso-motor stimulation contracting the cerebral supply vessels and lessening the quantity of blood circulating in the brain (Hammond). That there is a relative anæmia of the brain during sleep is well established, but recent experimental researches have proved that such is the result rather than the cause of inactivity of the mental faculties. It is shown that hypnotics may induce deep sleep without altering the quantity of blood in the cerebral vessels; and that although, in prolonged sleep, the brain becomes pale and bloodless to some extent, during the earlier stage of artificial sleep there is no indication of cerebral anæmia (Binz). Furthermore, patients suffering from general anæmia due to hæmorrhage, chlorosis, etc., often suffer from obstinate insomnia; and conditions of plethora are frequently attended with troublesome somnolence (Vulpian). The latter observer denies that ligature of the carotids in animals produces a state resembling true sleep, and states that faradization of the cephalic ends of the two divided cervical sympathetic cords, while producing considerable cerebral anæmia, does not cause the slightest tendency to somnolence; hence, that the valvular and cardiac modifications observed are "only accessory, concomitant, or consecutive, playing no essential rôle in the physiology of sleep."

The present view is that normal sleep is a condition of rest of the nervous system, in which the energy expended during the waking hours is renewed and the higher nervous centres are protected by unconsciousness from the stream of impressions flowing in from the organs of sense—in which waste products are eliminated from the cerebral centres and the cerebral tissue is recuperated for another period of activity. This theory regards normal sleep as the expression of more or less exhaustion of the cerebral elements. All hypotheses advanced to account for the precise changes which produce sleep are unsatisfactory; the most reasonable one is that it is probably induced by toxic material generated by the activity of the cerebral cells (Preyer), and that hypnotics act similarly upon the same elements. From this point of view, sleep and coma, as well as the action of hypnotics and narcotics, are merely different degrees of the same condition; which is strengthened by the fact that many of the most efficient hypnotics are also narcotic in sufficient dosage.

The intimate nature of hypnotic action is as yet undetermined, but experiments on trephined dogs with large doses of potassium bromide (Albertoni), and more recently with gold bromide (Shtcherbak), show that these agents reduce the excitability of the cortical motor centres to such a degree that the strongest electrical stimulation fails to induce

an epileptic paroxysm. In some of these experiments the brain was pale, but not so in others, hence the lessened excitability could not be attributed to anæmia. It is, however, still held that slight and gradual anæmia of the brain is conducive to sleep, as shown by the well-established utility, in many cases of insomnia, of hot pediluvia, with cold to the head and back of the neck.

Insomnia is promoted by anything which excites the centres of conscious mentality and keeps them functionally active, inasmuch as a torpid condition of these centres is the essential condition of sleep. The causes of insomnia are (*a*) psychical and (*b*) physical—under the former head being included all internal causes not directly dependent on organic conditions or external excitation, such as emotion, thought, and worry, for which the pure hypnotics are generally sufficient. Physical causes include *pain* however originating, requiring the removal of its cause or the exhibition of analgetics; *cerebral hyperæmia* from mental overwork, particularly when conjoined with insufficient physical exercise, from alcohol and other toxic agents, excessive heat, arterial degeneration, acute inflammatory disease, irritation by tumours, tubercle, etc.; *cerebral anæmia* from hæmorrhage, profuse discharges, exhausting diseases, insufficient food, anæmic cachexiæ, aortic valvular disease of the heart, etc.; *neuroses*, such as hysteria, mania, melancholia, and insanity; *dyspnœa* and *cough*, as in pulmonary and cardiac disorders. Indigestion, chronic cystitis, genital irritation, continued fevers, syphilis, rheumatism, and gout, are productive of insomnia, as are also most of the maladies which the human body is liable to.

Hypnosis may be brought about in several different ways—namely: by removal of any apparent external cause of insomnia; by derivation of the cerebral blood-supply; by elimination of toxic material, medicinal or pathological; by reconstruction, in conditions of defective nutrition; by restoration of normal function, cerebral, pulmonic, cardiac, etc.; by suspension of the consciousness of pain; by lowering cerebral activity until its waste is repaired. The last two methods, though frequently necessary, are the least desirable, especially when accomplished by agents which interfere with elimination, surcharging the blood with effete or toxic material, or by those which induce injurious changes in nerve tissue or in the blood.

The cerebral circulation may be lessened by contracting its arteries, by lowering the cardiac action, by expanding the vessels of other parts of the body, especially the abdominal arteries, and by depressing the functional activity of the cerebral cells. The latter may occur as a result of lessened cerebral circulation, venous congestion of the brain, or the action of agents which produce direct depression of the cerebral cells. The last two are operative factors in the production of coma.

Hypnotic Measures, not medicinal, are often fully as efficient as hypnotic drugs in producing sleep. When an external cause of sleeplessness is known, its removal will usually be sufficient to induce sleep. Many persons have become so adjusted to continuous noises that the stopping thereof produces insomnia, and in such cases the renewal of the familiar sounds will act as a hypnotic. A hot bath acts derivatively upon congested organs, and may so distribute the circulation as to relieve distress and wakefulness caused thereby. Hot foot- and sitz-baths, as means of derivation, are often efficient hypnotic measures, and every one has experienced the difficulty of obtaining sleep with the feet cold. A hot abdominal compress is frequently beneficial as a means of hypnosis, and the cold wet pack is a derivative and calmative of high rank. Massage and electricity, when used with a clear understanding of the condition to be corrected, as can only occur when they are applied under the direction of a physician, are valuable derivatives, but if improperly employed may greatly aggravate the insomnia. Galvanism and franklinism have been successfully used in many cases of obstinate wakefulness, and probably act by improving the tone of the vessels and the nutrition of the cerebral tissue. The range of the usefulness of electricity as a hypnotic is, however, almost limited to neuropathic or neurasthenic cases. The mere stoppage of cerebral excitants, such as tea and coffee, from the diet, proves efficacious in many instances.

Medicinal Hypnotics are theoretically indicated only when insomnia is continuous and therefore dangerous. They should not be continued for any long period of time lest a drug habit be formed, which is especially liable with the narco-hypnotics. To seek for the cause of wakefulness and remove it is theoretically the best rule of practice, but, like many other such rules, it is more honoured in the breach than in the observance, internal causes being too often conjectural and the exigencies of practice usually imperative for immediate results.

The medicinal hypnotics are fully described under their respective titles throughout this work, but a brief *résumé* of the hypnotic action and uses of the most important agents may be of value in this place.

Alcohol is a narco-hypnotic, acting chiefly by virtue of its narcotic power, but also by its stimulant action on the circulation in the insomnia sometimes seen in passive cerebral hyperæmia. Among the malt beverages, ale is considered especially hypnotic, the hops which it contains undoubtedly aiding to produce its effect. Whisky is more hypnotic than other spirits, but should be of pure quality, distilled (not mixed), and the older the better, as new liquors and those adulterated with the higher atomic alcohols are excitant and productive of insomnia. The proper dose of good old whisky, for one non-habituated to the use of alcohol, is from 1 to 2 fl. oz., taken in hot water when retiring to bed. The sleep produced by alcohol is, however, transient, usually lasting only two or three hours; but if a medium dose of sulphonal (15 grains) is taken at the same time, the hypnotic action thereof will be about beginning when that of the alcohol is declining,

and a continuous sleep of many hours' duration will usually follow in suitable cases.

Amylene hydrate, a tertiary alcohol, is a reliable hypnotic in doses of from 1 to 1½ drachm taken in any weak wine or in mucilage and water. It ranks between chloral and paraldehyde, but is safer than the former and more agreeable than the latter. In its hypnotic dose its action is expended upon the cerebrum, and it has no perceptible action on the heart or respiration and no unpleasant after-effects; but very large doses are narcotic also paralyzing to the cardiac and respiratory centres. Von Mehring used it in sixty cases of *insomnia* of the most varied character, in only four of which it proved inefficient. It is an expensive drug and has not come into general use, though it may be safely given to children in doses suitable to their age.

Bromides are pure hypnotics and the least objectionable agents for the relief of simple *insomnia* or that due to abnormal excitability of the brain. They are usually efficient in the wakefulness caused by severe mental strain, intense emotion, or worry, and in that of hysteria, insanity, hypochondriasis, the night-terror of children, and mild forms of delirium tremens. As usually administered for hypnotic purposes they are harmless, but if taken in excessive doses continously for some time they are apt to produce great mental and muscular depression, acne, hallucinations, and other serious phenomena of bromism. Bromides should not be given in anæmic cases, and the potassium salt should be avoided in all cases where the heart's action is markedly weak. It frequently acts well as a hypnotic in febrile affections, and as long as the temperature is high and the pulse strong it is the most suitable bromide in such conditions. Sodium bromide is the best for hypnotic use, being the most hypnotic and the least toxic of the bromides in general employment. The dose of either is from 20 to 40 grains, dissolved in at least 2 oz. of water, and repeated if necessary at intervals of two hours. All bromides should be administered in free dilution, as they will produce gastric irritation if given in concentrated solution.

Cannabis indica is one of the best hypnotics in delirium tremens and in the treatment of the opium habit. It is a narco-hypnotic and in efficient doses generally produces very decided and unpleasant effects, such as giddiness, headache, hallucinations, delirium, nausea, disturbances of the circulation, palpitation of the heart, increased pulse-rate, etc. Large doses of an active preparation cause a condition of coma-vigil rather than one of sleep, with decided symptoms of mental alienation. It is a very unreliable drug, no two samples being equally active, and individual susceptibility to its action varying greatly. The hypnotic dose is from 3 to 5 grains of a good alcoholic extract, or from ½ to 1 fl. drachm of the tincture. Its hypnotic action seems to be increased by potassium bromide.

Cannabine tannate is considered by Fronmüller a very useful hypnotic, efficient, not dangerous, not disturbing the secretions or being followed by unpleasant after-effects, and of especial value in the *insomnia of mania*. The dose ranges from 2 to 10 grains, the average being 5 grains.

Chloral hydrate is undoubtedly the most efficient of all hypnotics, a dose of 30 grains usually producing in from ten to twenty minutes a quiet, dreamless, and refreshing sleep closely resembling the normal, lasting from two to six hours, with slow and regular pulse and respiration and contracted pupils, from which the subject may be readily wakened, falling asleep again quickly when permitted. No disagreeable after-effects are experienced, as a rule, and there is ordinarily no preliminary stage of excitement. In some cases, however, usually after small doses (from 8 to 15 grains), a period of excitement may precede the sleep, with injected face, restlessness, and hallucinations; and on awakening there may be headache, a sense of fatigue, and heaviness. As a hypnotic, chloral has many advantages, acting quickly and certainly and without unpleasant after-effects. It is not a pure hypnotic, though often so classed, as it is profoundly narcotic in large doses. It may be employed in almost all cases of insomnia, except those due to pain, provided no contra-indications exist; but it should be reserved for occasional, not habitual, use, as it is apt to induce a chloral habit, the results of which are very serious (see CHLORAL). It is contra-indicated where there is a feeble heart due to fatty or other forms of degeneration, valvular disease, dilatation, or malnutrition, as in the later stages of continued fevers, also in catarrhal and ulcerative affections of the stomach, and in hysteria. In the latter affection it frequently causes undue excitement; and in diseases which interfere with the respiratory process (such as pneumonia, pleurisy, emphysema, and bronchitis) it may produce delirium and great depression. Its dangers are due to its depressant action on the vaso-motor centre and the cardiac ganglia, which is very great in overdoses and where cardiac or pulmonary disease exists.

The hypnotic dose of chloral for an adult in whom no contra-indications exist ranges from 20 to 40 grains; but it is best to administer a full average dose of 30 grains rather than have to repeat smaller ones. It should be administered in dilute solution, fully 1½ or 2 fl. oz., to avoid nausea and gastric irritation. The taste is well concealed by cinnamon water. It is frequently administered in conjunction with an equal quantity of potassium bromide, which is also a cardiac depressant; and when pain is present the addition of ¼ of a grain of morphine sulphate to the first dose will greatly increase the hypnotic effect. It may be given by rectal injection when the condition of the stomach precludes its administration by the mouth: but it should never be used hypodermically, being very apt to cause death of the tissue with subsequent sloughing thereof.

Chloralamide, a combination of chloral and formamide, is an excellent hypnotic and also somewhat analgetic, without depressant action on the cardiac or respiratory mechanism. It

is particularly useful in simple *insomnia*, that from nervous excitement, neurasthenia, hysteria, cardiac or pulmonary disease, typhoid fever, and diabetes mellitus. It is somewhat less hypnotic than chloral hydrate, but is unquestionably safer. The average adult dose is 30 grains, but 40 grains are considered necessary by some observers. Its hypnotic action is produced in about an hour after its administration. It should be given in dilute alcoholic solution, a teaspoonful of whisky or brandy with a little cold water; never in hot or even warm solutions, as a heated preparation decomposes. It is a proprietary preparation, of foreign manufacture, patented and trademarked.

Croton-chloral (butyl-chloral hydrate) is feebly hypnotic as compared with chloral, but much safer, having but slight depressant action on the vaso-motor centre and the heart. It specifically affects the fifth nerve, and acts well in *insomnia* due to neuralgia thereof, also in that accompanying cardiac disease. The average dose is 10 grains, but 20 grains may be given, in capsules or cachets.

Hyoscyamus is generally considered a feeble hypnotic, but has been found quite efficient when *insomnia* is due to motor excitement, delirium tremens, the delirium of fevers, acute cystitis, or nervous cough. It belongs to the narco-hypnotics, and is deemed an excellent substitute for opium in children. The dose of the tincture is from $\frac{1}{2}$ to 1 fl. oz. for an adult; from $\frac{1}{2}$ to 2 fl. drachms, according to the age, for children. Full doses are necessary for its hypnotic effect, and it may be well combined in prescriptions with potassium bromide.

Hyoscine, the amorphous alkaloid of hyoscyamus, is one of the most powerful hypnotics known, having the advantages of being tasteless and requiring to be given in a very small dose. It is particularly useful in the *insomnia* of *acute mania* and of *delirium tremens*, and in other conditions presenting grave excitement with motor disturbance; also in that due to the withdrawal of *opium* from persons addicted to it. It usually produces some aggravation of excitement for a time, but deep sleep almost invariably follows and continues for several hours. Dryness of the mouth and throat, dilatation of the pupils, and other symptoms produced by the *Solanaceæ* are experienced to some extent on awaking, but in ordinary doses the drug produees no ill consequences. Full doses ($\frac{1}{50}$ of a grain) are slightly depressant to the heart and more so to the respiration, but in large dose hyoscine is a dangerous depressor of the respiratory centre. The hypnotic dose of the hydrobromide or hydrochloride is from $\frac{1}{120}$ to $\frac{1}{60}$ of a grain hypodermically, or from $\frac{1}{100}$ to $\frac{1}{50}$ of a grain by the mouth, beginning with the smallest and gradually increasing the dose as its use is continued. It may be administered in tea, coffee, milk, etc., without the patient's knowledge.

Opium and its Alkaloids.—When opium acts as a hypnotic it is a most efficient one, but, unfortunately, it does not produce this effect on all persons in the same doses or in many forms of *insomnia*. The only trustworthy indication for its hypnotic use is the presence of pain or great restlessness, and when these are the cause of sleeplessness opium or morphine, in proper doses, will act more certainly and efficiently than any other drug. When insomnia is due to severe pain a larger dose of opium will be required than in cases dependent on mere peripheral irritation. Opium is essentially a narcotic, and the character of its action depends on several factors in any case, such as the size of the dose, the age and idiosyncrasy of the patient, morbid or other opposing conditions present, etc. In many cases an ordinary hypnotic dose produces no sleep whatever, but causes high mental excitement and the other stimulant effects of the drug; in others the hypnotic action is preceded by a period of wakefulness, with hallucinations and even delirium in exeitable women. Its hypnotic action is now believed to be produced by a double influence—(*a*) on the vascular system, causing primary hyperæmia and secondary anæmia of the brain; (*b*) on the cerebral cells, diminishing their activity and consequently lessening their demand for blood. During the opium sleep the subject is readily awakened unless the dose has been excessive, in which case the cyanosed face, the slow and feeble pulse, the slow and stertorous breathing, the minutely-contracted (pinhead) pupils not reacting to the presence or absence of light, sufficiently indicate the presence of opium narcosis. Its after-effects are numerous and positive—headache, anorexia, constipation, a torpid action of the liver, dysuria, mental depression, itching of the skin, especially that of the nose, and often nausea and vomiting.

Opium as a hypnotic is partieularly indicated in the insomnia due to pain or to *cardiac dyspnœa*, and in that of the later stages of fevers from exhaustion and cerebral anæmia. It is contra-indicated when sleeplessness depends on cerebral hyperæmia, which it will aggravate, in the insomnia of alcoholism, and in *delirium tremens;* also in that due to *dyspnœa of pulmonary origin*, especially *chronic bronchitis* with profuse secretion, and generally in children, particularly infants, who are very susceptible to its narcotic action. It is best avoided in chronic insomnia from whatever cause, as its continued use will certainly produce the opium habit; but this alternative must be faced in cases of persistent wakefulness from asthma due to valvular cardiac disease. The hypnotic dose of opium is about 1 grain, or a corresponding amount of its various preparations; but smaller doses often suffice, and it is generally better practice to give a small dose and repeat it once or twice than to give the full dose at once. Its continuous use requires increasing doses to produce its hypnotic effect.

Among the hypnotic alkaloids of opium, *morphine* has an action identical with that of the drug itself, but, being capable of hypodermic administration, it may be more rapidly and certainly effective, as when so given it frequently produces sleep in from ten to twenty minutes in appropriate cases. Its hypnotic

action is promoted and its ill effects are prevented to a great extent by the conjoined administration of $\frac{1}{120}$ of a grain of atropine. The hypnotic dose of the sulphate or hydrochloride is about $\frac{1}{4}$ of a grain by the mouth, or $\frac{1}{8}$ or $\frac{1}{6}$ of a grain hypodermically. Its continuous employment as a hypnotic requires increasing doses and will induce the morphine habit. *Codeine* is less powerful and less certain as a hypnotic than morphine, but is much less apt to cause a drug habit, and is decidedly preferable for insomnia due to cough, to the pain of rheumatism and of cancer, to abdominal pain; also when constipation should be avoided, and when opium or morphine is not well borne. The hypnotic dose of codeine varies with individuals; in some $\frac{1}{4}$ of a grain is sufficient, in others a grain is necessary.

Paraldehyde is one of the most reliable and safe hypnotics, having many of the qualities with none of the dangers of chloral, as in medicinal doses it slows and strengthens the heart's action instead of weakening it, and does not depress the respiration. The sleep produced by it is even more rapidly attained than that of chloral is, but is more transient, lasting only a few hours. It has been used satisfactorily in the *insomnia* of *mania*, *hysteria*, *hypochondriasis*, *delirium tremens*, *fevers*, *rheumatism*, etc., but is of no value in sleeplessness due to pain. In some cases of cardiac disease, in which the heart's action was very weak, it caused no noticeable depression thereof. It is contra-indicated, by reason of its acridity, in irritable conditions of the throat and stomach. Its taste and smell are very disagreeable to some persons, and it imparts to the breath a very unpleasant odour, which may persist throughout the next day. It occasionally causes an erythematous eruption, and may induce cerebral congestion and vasomotor paralysis if used for a long time. A toxic dose (1 oz.) is said to paralyze the medulla oblongata and the respiratory centre therein. A paraldehyde habit is occasionally formed, and is accompanied by serious disturbance of the vaso-motor system and the mental faculties. The hypnotic dose is from 1 to $2\frac{1}{2}$ drachms, which should be prescribed in dilute alcoholic solution or simple elixir, and further diluted with water before ingestion. If given in concentrated solution it will produce burning pain in the mouth and throat, also gastric pain and irritation.

Sulphonal is classed as a pure hypnotic, and is a very efficient one in most cases of simple *insomnia*, yet it frequently fails, and having no analgetic power, it is useless when pain is present. It is free from the objectionable qualities of chloral, but has its own drawbacks; it is very slow of action, requiring to be given two or three hours before its hypnotic effect is desired. The sleep produced by it lasts from six to eight hours, and may be followed by drowsiness lasting through the following day and night, particularly when the drug has been administered in powder and left to dissolve in the gastric contents. It produces no depression of the heart or respiration, but sometimes restlessness, hallucinations, giddiness, and confusion of thought have taken the place of sleep after its ingestion. Recently several cases of its toxic action have been reported, the phenomena thereof being manifested upon the nervous system, and it is losing its character as a pure hypnotic. Ataxia with staggering gait, mental depression, cessation of menstruation, feebleness of the limbs, ptosis, and symptoms of ascending paralysis are some of the results of its continuous use. The dose is 30 grains for a man, 20 grains for a woman, dissolved in hot milk, tea, etc., and given about two hours before going to bed. A more immediate effect may be produced by administering it in hot whisky punch, as directed under the head of alcohol. It should be taken but once daily, and discontinued on the first sign of toxic action. It is a foreign proprietary preparation and somewhat expensive.

Trional, differing chemically from sulphonal in possessing three ethyl groups instead of two, is also a very efficient hypnotic, less prone than the latter to toxic action, but requiring to be given in doses fully as large. It is especially useful in cases of slight psychical excitement accompanied by obstinate *insomnia*, and is said to act promptly and efficiently in many forms of *delirium*. When pain is present, as in neuralgia, its conjoint administration with phenacetine or acetanilide is generally successful in producing sleep. It has been used with satisfaction for the insomnia of patients under treatment for morphinism. The hypnotic dose is from 20 to 40 grains, dissolved in whisky and water or wine. It also is a foreign proprietary preparation, patented in this country by its German manufacturer, and expensive.

Of the other hypnotic drugs, *hops* and *lettuce* have very feeble action; *hypnone* is feeble and unreliable, of very unpleasant odour and taste, and causes gastralgia and vomiting; *methylal* is weak, often fails, and is very expensive; *urethane* is feeble and uncertain; *acetal* is equally so, with a nauseous taste and odour; *somnal* made a noise for a time, but has fallen into disrepute; *tetronal* has no advantage over trional, besides being difficult to obtain in this country, on account of a trade quarrel; and *piscidia* is somewhat uncertain in action, though its hypnotic and anodyne powers have proved very decided in many cases.

SAMUEL O. L. POTTER.

HYPNOTISM.—Hypnotism is a subjective psychical condition, and is composed of hypnosis, a pseudo-sleeplike state, in which the subject's susceptibility to suggestions is increased, and usually a post-hypnotic period of variable length, during which certain acts suggested during the state of hypnosis are performed. Hypnotism, like many physical conditions, is difficult to define. The foregoing definition is imperfect, but it seems to convey some idea of the subject, and this must be my excuse for the attempt to define an almost indefinable series of phenomena. There is an increased susceptibility to suggestions during the period of hypnosis, and the acts suggested during this state may be performed while the subject is in a condition of primary

hypnosis, or during the post-hypnotic state, according to the wish and suggestions of the hypnotist. The presence or absence of a post-hypnotic state will depend upon whether the operator makes any suggestions while his subject is in a condition of hypnosis for him to carry out after returning to his normal condition. If no suggestions have been made during the period of hypnosis that are in any way to modify the condition, thoughts, or actions of the subject after returning to normal consciousness, there will be no post-hypnotic state.

According to Moll,* "a person in a hypnotic state is called a hypnotic, or subject. A hypnotist is a man who hypnotizes for scientific purposes. A hypnotizer is a man who makes hypnotism a profession." A post-hypnotic suggestion is one made during the period of hypnosis for the patient to follow out after the hypnosis passes away.

It is no longer necessary in writing on hypnotism to waste words in discussing whether the condition is real or imaginary. Every careful, conscientious, and scientific observer who has thoroughly investigated the subject has been convinced of its genuineness. Credulity, superstition, and at times chicanery and fraud, have been from time immemorial so intimately associated with hypnotic exhibitions that, until of late, but few honest and scientific workers have dared to investigate the subject, and even at the present time only a comparatively small number care to make known the results of their investigations of hypnotism, lest the epithet "knave or fool" should be applied to them.

Hypnotism has a medico-legal and a psychological interest, but its importance in therapeutics will never be determined without a more impartial and extended trial than it has yet received at the hands of the clinician. It seems fitting that a handbook devoted to practical therapeutics should have a space, be it ever so short, assigned to hypnotism. In this article, which is to be limited to a few thousand words, there is no room for the discussion of theories.

Inducing Hypnosis.—There are several methods by which hypnosis may be induced. I shall only briefly refer to the principal ones, and describe more in detail the method which I have found attended with the least nervous disturbances to the subject hypnotized. Every investigator soon learns to modify the manner of effecting hypnosis according to the peculiarities of the subject. The method which I have adopted is similar to the one usually practised at the school of Nancy. I have found it advantageous to my patients to avoid, during the induction of hypnosis as well as during the hypnotic state, everything that tends to excite the subject or increase his nervous tension. Hypnosis may be brought about by requesting the patient to fix his eyes intently on some bright object, such as a shining metal or glass button held a little to one side of and above the head, a spot on the ceiling, or revolving mirrors, until the eyes tire and close from fatigue, when the hypnosis may be completed by passes, from above downward, continued for a few minutes. Professor Charcot employed at times, especially for the hysterical, a sudden flash of an electric light, the noise of a loud-sounding gong, or a stern command to sleep. Others use a species of fascination by requesting the subject to look the hypnotist fixedly in the eyes until suggestive movements are made or spoken commands obeyed. Some employ passes, with or without suggestion, and accomplish the same object. A combination of these methods is said to be employed by some hypnotists with advantage. After trying most of the methods referred to, I have abandoned them, except in special cases, for the following:

I first explain to the subject that hypnosis is nothing more than a condition in which he voluntarily places himself by allowing his mind to follow my suggestions to the exclusion of every other thought. That I have not and never shall have any power to put him to sleep without his consent and desire. That after I get him to sleep I can make suggestions which he will carry out in his normal state without thought or voluntary effort on his part, and by this means he will to a great extent be able to keep his thoughts off himself or his ailments. After the patient has comprehended what is desired he is placed in a comfortable position, either sitting in an easy high-backed chair with a place to rest the head, or lying, when I request him to close his eyes and think that he is experiencing the phenomena of sleep as I suggest them, telling him the whole matter is in his hands and I have nothing to do with his sleeping except as I suggest sensations, which he will feel if he keeps his mind on what I am saying. In every case I endeavour to free the patient's mind of any thought of the mysterious. I now request him to think of sleep, of going to sleep, and repeat: "Your eyelids are getting heavy: you begin to feel drowsy; your head is full; you are more inclined to sleep; your eyelids are getting heavier; you are feeling more and more drowsy; your arms begin to feel numb, heavy, and powerless; a sleepy sensation is now coming all over you—in your head, arms, body, and legs—and you feel a tingling in your hands and feet; my voice seems faint to you and to come from a distance; your eyelids are now decidedly heavy, and you are going fast to sleep, but it is a quiet, soothing sleep; now you are fast asleep and can not open your eyes." If the patient can not open his eyes after I request him to do so, I begin to make the necessary therapeutic suggestions regarding his ailment.

It is not necessary in persons who are easily hypnotized to make so many repetitions as I have given above, except at the initial trial, when the suggestions regarding the sensations one experiences while going to sleep may have to be repeated over and over again. Some persons who are unable to concentrate their minds sufficiently to get into the hypnotic condition by the suggestive method may suc-

* Albert Moll, *Hypnotism*, p. 26.

ceed after gazing for a few minutes at a bright object held just above and to one side of the head, but I have rarely succeeded in inducing hypnosis in a subject by any other means after I have made repeated ineffectual attempts by the method outlined.

In the use of hypnosis on the timid, I assure them for the first *séances* that they shall know and remember everything that I have done or said. After gaining their confidence, if a deeper condition of hypnosis than what has been obtained is desirable, I inform them that I wish to put them into a deeper sleep to obtain the necessary results from suggestion, but I never attempt to induce such a condition without first obtaining their consent.

For a person to make a successful hypnotist he must be positive in his manner and assertions and capable of inspiring confidence in his patients. A person is not in a good condition to be hypnotized unless his mind is free from anxiety, worry, and excitement. His body should be in an unconstrained and comfortable position throughout the *séance*. Patients whom I had repeatedly hypnotized have come to me in an excited and worried state, and I have endeavoured long and patiently to hypnotize them, but have signally failed. They would say that they were unable to keep their minds on sleep or my suggestions. An initial hypnosis should not be attempted unless the subject is comparatively calm and self-possessed. Judging from my own experience, the foreign element of our population are more easily hypnotized than the native-born American. It seems to be the conclusion of most hypnotists that, when the method of the school of Nancy is employed, the more nervous and hysterical the subject the greater will be the difficulty in inducing hypnosis. Moll and many others state that there is little difference between the two sexes in affecting hypnosis. This may be true of the masses whom many experimenters in continental Europe have utilized for the investigation of the psychological and medico-legal aspects of hypnotism, but in my employment of this agent solely for its therapeutic effects in nervous affections men have made the most satisfactory subjects. Mentally weak, fickle, and very impressible people are difficult to hypnotize. The feeble-minded, the insane, and children of a very tender age do not readily yield to hypnosis. Self-possession, the ability to concentrate the thoughts on the things suggested to the exclusion of all others for the time being, a desire to be hypnotized, and confidence in the hypnotist are the most potent factors that aid in making one susceptible to the hypnotic influence. Ignorance and education, of themselves, have little or no influence on the induction of hypnosis, but it is often found almost impossible to hypnotize the busy and overworked professional man, not because he is educated, but owing to the multitude of thoughts, cares, and worries which prevent his concentrating his mind on suggestions, to the exclusion of everything else, without which it is impossible to induce hypnosis by the suggestive method. It is sometimes impossible to hypnotize an ignorant, superstitious person, not because he is ignorant, but from the fact that his mind is disturbed by superstitious fears of hypnotism. In the lower walks of life, those who possess the most common sense are the most easily hypnotized. The persons who have been trained to implicit and unqualified obedience to commands most readily yield to hypnosis. Soldiers and sailors make good subjects. I believe any one who can concentrate his mind on suggested trains of thought relating to the natural phenomena of sleep, to the exclusion of every other thought, is capable of being hypnotized. It will be seen by this that for many to become hypnotizable is a matter of training the mind to follow suggestions. One person will do it at the first attempt, a second after two or three unsuccessful efforts, a third may not succeed until after daily *séances* extending over two or three weeks, while a fourth may fail entirely because the power of mental concentration on one subject suggested by another person, to the exclusion for the time being of every other thought, is wanting.

In estimating the proportion of persons who are hypnotizable, many modifying circumstances have to be taken into consideration. Not the least of these is the personal influence of the hypnotist. Some may be hypnotized by one person and not by another of equal experience. He who succeeds in getting his subject *en rapport* with himself will usually be able to induce the hypnotic state. According to Moll,* Liébeault hypnotizes ninety-two per cent. of his patients; Bottey, thirty; Delboeuf, over eighty; while Bernheim refuses the right to judge of hypnotism to all hospital doctors who can not hypnotize at least eighty per cent. of their patients. The longer one practises hypnotism, and the more thoroughly he becomes acquainted with its phenomena, the more easily will he be able to induce hypnosis, but the fact will always remain that some will be able to affect a greater proportion than others. It is in the employment of hypnotism as it is in the use of other agents; the personal equation of the experimenter plays a part of no small importance.

It may be accepted as a general rule, to which there are few, if any, exceptions, that repeated hypnosis in a person makes the process easy. In endeavouring to hypnotize certain nervous and hysterical subjects I have most nearly succeeded at the first *séance*, and have failed more and more at each subsequent attempt until finally no approach to hypnosis could be induced; but in no instance have I failed to induce hypnosis at subsequent *séances*, provided the patient was in good condition, if I had succeeded at previous sittings.

The manner of arousing a subject from hypnosis is simple, but, on account of its simplicity, insufficient stress has been laid upon it by some writers on hypnotism. The hypnosis may usually be ended by bidding the subject awake, or by telling him that he will awake in a few seconds or minutes. If the subject has acted nervously during the hypnotic state, or

* Albert Moll, *Hypnotism*, p. 47.

if any disturbing suggestions have been made, he should not be aroused until his nervous state has been overcome by soothing words from the hypnotist or the perturbing suggestions have been cancelled by counter-suggestions. It is better not to arouse the subject suddenly, and this is especially true for the nervous and hysterical. It is well to prepare the subject by telling him that when he awakens he will feel calm and quiet, and that there will be no sense of fatigue or mental depression, after which he may be told he will awake within ten or fifteen seconds feeling well and happy.

Stages of Hypnosis.—Much has been written by Charcot, Gurney, Richer, Fontan, Segard, Delboeuf, Liébault, Bernheim, Forel, Dessoir, and others concerning the classification of the states of hypnosis. The classification suggested by Max Dessoir, and provisionally accepted by Moll,* is probably the best, as it is the simplest, but it must be remembered that, no matter what classification of the states of hypnosis is adopted, there is no constant and distinct line of demarcation separating the different stages. Dessoir divided the different states into two groups. In the first voluntary movements are disturbed, while in the second sensory phenomena are added. It will be seen that in the first group the changes affect centrifugal impulses, and in the second sensory impressions are altered. Charcot's classification consists of the cataleptic, lethargic, and somnambulic states. Hypnosis may vary in degree from the slightest disturbance of the normal condition, in which the subject may be apparently conscious of everything that is said or done, to deep sleep, almost amounting to stupor, in which the person is oblivious to his surroundings for the time being. The more one endeavours to study hypnotism for therapeutic purposes, according to any of the various classifications of the different states of hypnosis, the more impracticable any classification seems, and individual experience in dealing with different persons is the best guide as to the depth of hypnosis that it is necessary to obtain to make suggestions of the greatest value. Moll believes that the deeper the hypnosis the better the effects of suggestion.

Some of the organic functions of the body may be influenced by suggestions made during the state of hypnosis. An evacuation of the bowels, increased appetite, or an abnormal flow of saliva may be caused by suggestion. Rigidity or paralysis of muscles, like the anæsthesia found in some cases of hypnosis, is due to suggestion. Memory may be preserved or abolished according to the will of the hypnotist for everything that occurred during the period of hypnosis. In the deeper states of hypnosis, even without suggestion, memory may be lessened or entirely lost for what has taken place during this period.

The psychical condition of the hypnotic state has been discussed by almost every writer on the subject, and various theories have been advanced to explain the phenomena. As stated in 1891,* in my experiments with hypnotism, I have limited my investigations largely to the therapeutic applications of the subject, and have not studied the psychical condition of the subject under hypnosis as much as I should like. It seems to me that when a person allows himself to go to sleep by external suggestion he voluntarily gives up his will power over his thoughts and actions, and places his mind in a state to follow, to a greater or less extent, the suggestions made by the hypnotist. One mental state is replaced by another; the ordinary thoughts of the individual are replaced by the suggestions of a second party. Suggestions frequently repeated and strongly impressed by one during several hypnotic states, apparently, after a time, become so fixed upon the mind of the subject as to form a part of his thoughts and, to a greater or less extent, influence his actions; hence, post-hypnotic suggestions are frequently as faithfully carried out as those followed out during the period of hypnosis. For one to be hypnotized with the greatest effect he must voluntarily place himself in a passive condition, or voluntarily and involuntarily think of the train of thought suggested by the hypnotist. When this train of thought consists of the phenomena of sleep as they occur in natural sleep, hypnosis very readily follows. The subject, therefore, places himself to a greater or less extent in the hands of the hypnotist. After hypnosis is induced he is a passive agent, to a great degree, in the hands of the person who has induced the hypnotic condition—a state of mind most favourable for new mental impressions to be made, because there are no extraneous thoughts to distract the attention. There is, undoubtedly, some expectancy at work in the induction of hypnosis, but the carrying out of hypnotic and post-hypnotic suggestions depends upon the impressions made by the hypnotist upon the mind of the subject during the period of hypnosis. All the good or evil that has or may come from hypnotism is due to the influence of the mind upon the body.

It would be interesting in this connection to recall instances illustrating the influence of the mind upon the body, but these are the common property of every observer, and Tuke's excellent work † is replete with typical examples.

Diagnosis of the Hypnotic State.—The diagnosis of simulated hypnosis from the real hypnotic condition is as difficult as the diagnosis of feigned from real insanity, and as the latter requires a thorough and practical knowledge of insanity, obtainable only by a careful study of the insane, so in the former one must be familiar with the hypnotic state as observed in a large number of hypnotic experiments before he can be certain of his ability to detect deception, and even then he is liable at times to be deceived. When the eyes are allowed to close as hypnosis is coming on, the manner in which this takes place is important. The

* Albert Moll, *Hypnotism*, p. 51.

* Hypnotism, *New York Medical Journal*, August 1, 1891.

† *Influence of the Mind upon the Body.*

movements are so similar to those which occur in a person overcome with a sleepy sensation while sitting reading or listening, that a simulator would probably close the eyes more suddenly than is done in hypnosis. When the eyes are voluntarily closed before an attempt at hypnosis is made, the manner of their closing is of no importance. The action of the occipito-frontalis muscle in the hypnotic's unsuccessful attempt to open the eyes is natural and difficult to feign. I have been able to detect simulation in several by observing this alone. The blank face and expressionless eye exhibited on suddenly arousing one from hypnosis are difficult to simulate. Sudden and unexpected irritation of the skin with a dry faradaic brush or the thrust of a pin will always cause some reflex action on the part of a simulator, but nothing of the kind takes place if anæsthesia is present in hypnosis. Muscular movements, as when the subject is told he is unable to raise his arm or let it fall, are slow, laboured, and jerky, very difficult to imitate. Nearly all movements performed in hypnosis are begun reluctantly, while a simulator does his part so cleverly that deception is evident from his overdoing.

Dangers of Hypnotism.—In discussing the dangers of hypnotism in this article those of a purely medico-legal character will not be considered, as these should find an ample space in works devoted to medical jurisprudence; besides, the space necessary to do the subject justice would be larger than that assigned to the entire subject of hypnotism in this work. It has been maintained by some—principally, however, by those who have had but little experience with hypnotism, or who have induced hypnotism by the methods practised by Braid and later by Charcot and his school—that by repeated hypnotization the subject becomes demoralized, loses self-control, becomes the tool of the hypnotist, and degenerates mentally. Mendel maintained that "it caused nervousness, it made the nervous and hysterical more nervous, and those who were not nervous soon became so after repeated hypnosis." It must be remembered, as Forel and Schrenck-Notzing pointed out, that Mendel used the Braid method. There is no doubt that the methods usually employed by Charcot and his pupils, such as tiring the subject by gazing at bright objects held in such a position as to strain the eye muscles, the sudden flashing of an electric light in the eyes of a hysterical subject, or stamping with the foot and in a loud and commanding voice bidding the person sleep, may result in great and dangerous nervous and mental strain, throwing the subject into a hystero-epileptic condition. Convulsions and insanity have followed such unjustifiable procedures. Liébeault, Bernheim, Forel, Moll, Felkin, and a host of others have failed to observe any bad effects from hypnotism when properly used as a therapeutic agent. In the employment of an agent that requires the surrender of the subject's will to that of the hypnotist, it seems to me we should at least be apprehensive lest it may result in weakening the will power and lessening the independence of the individual, especially when it is repeatedly resorted to and continued over long periods. Liébeault, who has practised hypnotism for thirty years, and who has frequently used suggestive therapeutics on the same individual for more than a year, has failed to observe mental weakness and decrease of will power as a result of this treatment. Moll considers one of the principal dangers from frequent hypnotization of the same individual to be the increased tendency to hypnosis on the slightest provocation, but thinks the danger is slight when the method practised by the school of Nancy is employed, especially if the proper precaution is taken to prevent such a result by suggestion.

Precautions Necessary in the Therapeutic Use of Hypnotism.—Hypnosis should not be induced any oftener than is absolutely necessary, and, to prevent the necessity arising too often, it is well at each hypnosis to suggest that the impressions will be lasting, and repeated hypnotizations will not be needed or desired. Unpleasant or exciting suggestions should be avoided during hypnosis if possible, and if we are compelled to use any, they should be counteracted by soothing suggestions before the subject is allowed to awaken. We should never allow ourselves to use suggestions to satisfy a morbid curiosity. The subject should always be told before awakening that nothing but good can result from the hypnosis, and that he will feel better, less nervous, and refreshed on awakening. A female should never be hypnotized except in the presence of a third party. The assurance should be made during each hypnosis that no one shall ever be able to hypnotize the subject against his will. If any delusion has been suggested during the hypnosis, it should be abolished before the person is allowed to awaken. The awakening should be done in soothing tones, and it is well for most persons, if not absolutely necessary for all, to arouse the patient slowly by telling him that he is gradually awakening, and he will be awake in a few seconds feeling quite well, without mental or physical depression. I have almost invariably observed these or similar precautions in the use of hypnotism, and, although I have induced hypnosis several hundred times during the last six years, I have not observed the slightest deleterious effect which could be attributed to it.

Therapeutic Value of Hypnotism.—I believe the therapeutic influences of hypnotism are due to mental impression. The value of hypnotism as a therapeutic agent depends upon whether the mental impression made upon a person in a hypnotic condition is capable of removing and taking the place of another mental impression of which the subject is possessed. Pain is the conscious recognition of irritation in some portion of the body. I can not conceive of suffering without consciousness, so that all mental and physical distress is the conscious recognition of some disorder which gives rise to the mental impression of suffering. It seems to me that much injustice has been done hypnotism as a

therapeutic agent by the extravagant statements made for it by some conscientious physicians. Whether it has or should have any place in therapeutics we must decide after giving it a fair trial. So many of the results alleged to have been obtained by hypnotism seem so exaggerated that one is led either to doubt the honesty of the hypnotist or suspect his judgment has been warped by enthusiasm. When I read of persons having been cured of fixed habits that had existed for years by one or two hypnotic treatments I can not help, with the results of my own experience, doubting the accuracy of such stories. In no case have I approximated success in permanently breaking any fixed habit, except by repeated hypnotic suggestions. If I am correct in believing that the value of hypnotism as a therapeutic agent depends upon the permanency of the mental impression made during hypnosis, it seems reasonable to expect that the impression must be made sufficiently often to become a habit. We do not contract a habit by doing a thing once. Now, when one habit or mental impression is to take the place of another that has existed for years, it seems to me that one is expecting too much if he thinks to accomplish this at two or three hypnotic *séances.* Of course, much depends upon the depth of the mental impression as to whether it will be transient or permanent. My experience has been that mental impressions made during hypnosis, if I endeavour as much as possible to avoid perturbing my patient, are not very permanent at first, and are only made so by repeated suggestions, extending over a considerable length of time. Although a person who has a fixed habit of which it is desirable to rid him may be readily hypnotized, yet hypnotic suggestions will have little effect in breaking up the habit until the subject desires such a result to take place. The desires of the subject in his normal condition, aided by the hypnotic suggestions, are potent in changing undesirable habits, but when the latter are opposed, or even unaided, by the former, they have but little or no permanent effect. I believe that hypnotism has a place in therapeutics, but I also am of the opinion that it is much less important than the writings of many hypnotists would lead us to conclude.

Pain Anæsthesia.—Inability to recognise painful impressions probably does not occur spontaneously in hypnosis, but it is the result of suggestion. Even with suggestion, pain anæsthesia is by no means universal in hypnosis. Were it not that we possess better and more reliable anæsthetics in chloroform and ether, hypnotism would to-day be extensively employed in surgery. Dr. Esdaile records two hundred and sixty-one surgical operations performed by himself in India while his patients were insensible to pain from hypnotic suggestion. Two hundred of the operations consisted in the removal of tumors varying in weight from ten pounds to one hundred and three pounds. Numerous surgeons have operated under similar conditions. I have induced pain anæsthesia in a few instances for the removal of teeth. It is only when the administration of an anæsthetic would be attended with danger that there is any excuse for resorting to hypnotism in surgery.

Hypnotism has been employed on a number of occasions for the relief of *labour pains.* If the patient has been hypnotized a number of times before labour sets in, the chances are that hypnosis will be effectual in relieving suffering during the parturient state, but considerable time and patience are required to accomplish the same thing that a few inhalations of chloroform will do in a very short space of time. Auvard and Secheyron, after employing hypnosis on thirteen patients in labour, came to the conclusion that hypnotism was an uncertain and inefficient anæsthetic, and produced a decided diminution in the force of the uterine contractions. (*Ann. of the Univ. Med. Sci.*, 1889, vol. ii.)

Organic Diseases.—The most that can be hoped for in the treatment of disorders of an organic nature from hypnotism is the relief of certain symptoms and the improvement of the organic functions, and thus aid given to Nature and art in removing the lesion and getting rid of its results. In some, despondency may be replaced by hope, pain assuaged, sleep induced, the bowels regulated, and digestion improved. My experience with hypnotism has been that very few cases of organic disorders are met with in which this agent is more efficient than others that are less troublesome. Occasionally, however, a chronic organic disease is encountered in which hypnotic suggestions are exceedingly valuable for the relief of pain and the inspiration of hope. Three years ago a case of cervical pachymeningitis of several years' duration, presenting atrophy of the muscles of the hands and areas of anæsthesia, was sent to me from a neighbouring State. Pain was so great that sleep could only be obtained by the use of morphine, and the patient had become mentally depressed because he found it almost impossible to sign his name to checks and official papers, an incapacity which would cost him his position in a large institution. He was easily hypnotized, and on suggestion that his pain would cease and he would no longer be despondent, he was able to sleep without morphine, and became hopeful instead of depressed. This man to-day is still occupying his position, and is able to write his signature legibly. The muscular atrophy is no less, but he does not suffer much from pain and despondency.

Functional Disorders of the Nervous System.—I have never succeeded in improving the condition of a typical hysterical subject by means of hypnotism, although many writers, among whom may be mentioned Van Renterghen, Eeden, Bidon, Stembo, Sperling, Bernheim, Danillo, Moll, Strübing, Mendel, Briand, Ringer, and others, report success in a fair proportion of cases; yet Danillo acknowledges that most of the cases relapse after they have been helped or cured. I have no experience with hypnotism in the treatment of *chorea*, but several cases have been reported cured by this means. In *epilepsy* I have signally failed. *Insomnia* may be cured in some instances by

repeated hypnosis, but relapses are frequent if hypnotic suggestions are not repeated from time to time. The cases of *stammering* which I have been able to help for a time relapsed after the treatment was discontinued. *Neuralgic pains* of a mild character may be relieved by hypnotism, but I have tried in vain to allay the acute pain of *odontalgia* and of *trigeminal neuralgia.*

Insanity.—I have never succeeded in hypnotizing an insane person. Voisin, of Paris, professes to have been able to hypnotize about ten per cent., and asserts that good results have followed in some instances.

Functional Gastro-intestinal Disorders.—In nearly every instance where I have used hypnotic suggestions in the treatment of functional gastro-intestinal disturbances the appetite has increased, digestion has improved, and the bowels have responded. Unfortunately, in most cases, hypnosis has to be repeated every few days, and patients relapse after the treatment is discontinued.

Vicious Habits and Tendencies in Childhood and Youth.—Many state that these can be lessened or broken up by hypnotic suggestion. I have had no experience with hypnotism in the treatment of these cases.

The Alcohol and the Drug Habit.—If I may judge from my own experience, the greatest field for the employment of hypnotism will eventually be found to be in the management of persons who are given to the abuse of alcohol and the use of morphine. Persons addicted to cocaine are so nervous and intractable that it is difficult to influence them by hypnotic suggestions, even when they are readily hypnotizable. Forel, Witterstrand, Tuckey, Tooth, and many others report excellent results in the treatment of *dipsomania* by means of hypnotism. Danillo's results were negative in two cases. Moll, in his work on hypnotism, relates six cases of chronic inebriety, eleven of morphinomania, and three of nicotism, cured. I have used hypnotic suggestion in the treatment of the alcohol and the drug habit in several cases, and have obtained varying results. In no instance have I succeeded in breaking up such a habit, or even lessening it to any great extent, unless the subject was desirous of being freed from it. To obtain the best effects from hypnotic suggestions the co-operation of the subject is necessary, and without this treatment, at least, will be prolonged and often unsatisfactory. If a person who is addicted to the alcohol or opium habit is hypnotizable and desirous of breaking off the habit, is it always possible by means of hypnotism to insure success? It is not. There are so many modifying conditions that it is not possible to predict with any degree of certainty what class of cases will give the best results. It is not wise to depend upon hypnotism to the exclusion of the other agents in treating these cases. Hypnosis, in most cases, will have to be repeatedly induced, as the subject is likely to relapse when left to his own unaided resources. The most effectual suggestions are those which assure the subject that he will have a disgust for the agent and its effects, and that those feelings which he had before experienced, and which had compelled him to resort to alcohol or opium, will not return.

Hypnotism has been employed with apparent success by a number of hypnotists for the relief of *menstrual disorders, onanism,* and *nocturnal enuresis.*

In conclusion, I wish to reiterate that while I believe that hypnotism, properly used, has a place in medicine, it is a rather limited one. In appropriate cases it is an aid to other measures and should be employed as the sole means of cure in scarcely any case, no matter how trivial the ailment may be.

JEREMIAH T. ESKRIDGE.

HYPODERMIC MEDICATION is the injection of remedies beneath the skin. The term hypodermic is etymologically unjustifiable and accuracy demands *hypodermatic* in its stead, but usage has perpetuated the error, and the method is almost invariably referred to as hypodermic injection. It is also described, and properly, as subcutaneous injection. The administration of medicines by hypodermic injection is a method of comparatively recent introduction, the latter half of the present century marking its elaboration and perfected accomplishment, though for some years previous to that time investigators had been engaged upon a number of remedial procedures which had for their basis the introduction of medicinal agents beneath the skin, and which were therefore essentially hypodermic. The question as to priority in devising the method is disputed, but for its introduction we are undoubtedly indebted to Dr. Alexander Wood, of Edinburgh, who in 1855 published an account of the method of subcutaneous medication. The practice as taught by Wood was not elaborated and its physiology was not thoroughly comprehended; in fact, he appears to have considered the local action of morphine, when given subcutaneously, as its most important one, though of its constitutional effect he was well aware. The correction of this and of other mistakes was not a matter of long time, and among those who contributed to the development of Wood's method as well as to its wider dissemination was Charles Hunter, whose first paper, Experiments Relative to the Hypodermic Treatment of Disease, appeared in 1859. From England the method soon spread and became enormously popular. In this country the late Dr. Fordyce Barker, of New York, appears to have been the first to employ Wood's method, though it seems proved that a similar practice was in operation in New York as far back as in 1839, in the hands of Dr. Isaac E. Taylor and Dr. Washington.

For the performance of hypodermic medication a special syringe is necessary. This syringe is a small one, usually containing not more than a drachm, which may be constructed of any one of several materials. Of these are hard rubber, glass, silver, German silver, and gold. The material is of greater importance to the individual than it is to the method, though, since cleanliness is of so much importance to the success of the treatment, the silver

and the more costly gold syringe would seem possessed of certain advantages. They lack the advantage of transparency, however, and glass, usually supported in a metal framework, is the material of which by far the larger number of syringes are made. The syringe is operated by a piston which in turn is composed of any one of a variety of materials, leather and rubber in particular. As a means of determining the amount of fluid injected, graduations (in this country the graduation is usually in minims) are marked upon the barrel or upon the piston rod, the latter being preferable, and in many cases the piston rod bears a screw thread upon which is movable a small button which, when placed at any desired point, prevents the injection of fluid beyond the amount indicated by the graduation at that point. Besides these piston syringes there are others which act by virtue of air-pressure, a handball being situated at one extremity of the syringe, which, by pressure and relaxation, effects the emptying and filling of the instrument. These syringes are certainly advantageous because of cleanliness, their simple construction—a handball, a glass barrel, and a needle—permitting their being taken apart and thoroughly sterilized, yet in operation they are bungling affairs and not comparable in utility with the piston syringe. The needles of the hypodermic syringe are all-important. They are usually composed of steel, of course are hollow, and are provided with a lancet point. The sharpness of this point and the preservation of that sharpness are very necessary, for the greatest pain may result from the insertion of a blunted needle, and, too, the greatest bruising of the tissues, with the inflammatory reaction which that implies. For similar reasons a needle of the smallest practicable calibre is to be desired. The hypodermic syringe requires constant care if it is to be preserved in a safe and efficient condition. Cleanliness is the essential, and to that end the syringe and its needle should be washed thoroughly after giving an injection, the needle in particular, because there otherwise will exist the possibility of conveying infection from one patient to another. Also it should be washed before each injection, especially if the apparatus has been some time in its case. A strong solution of carbolic acid (1 in 20) will be suitable for washing the syringe, but warm water is better than nothing and by no means to be despised when carbolic-acid solution is unobtainable. Some physicians are in the habit of passing the needle through a flame previous to inserting it for injection. This no doubt effects its sterilization, but it certainly injures its temper and contributes to its destruction. The bulb syringe, as I have already said, has the pronounced advantage of cleanliness, and for this a thorough scalding of the solid parts is a sterilization which, unfortunately, can not be used in the case of the piston syringe, because of the injury thereby produced in the packing. The syringe, when the injection is completed, should be well dried and returned to its case. In the piston syringe a small cap should replace the needle when that is unscrewed, lest air should get access to the piston and, drying it, injure the efficiency of the syringe. It is well also to leave a little water in the syringe to maintain the moisture, and hence the competence of the piston. The needles, when not in use, should have drawn through them fine steel wire, that thus their calibre may be maintained and that they may easily be cleaned. Too much care can not be bestowed upon the needles, and every effort must be made to preserve them free from rust and dirt.

The preparation of the solution for hypodermic injection is an important matter, for its nature must be such that its presence in the tissues will be well borne and its absorption from them rapid and complete. The solution should, as a rule, be aqueous, and in its preparation only water of purity should be employed. Not that it is necessary to use distilled water; on the contrary, that offers no apparent advantage over good well or river water. The solution should be perfect—that is, no portions of the medicament should remain undissolved, else they will act as foreign bodies to irritate and even to inflame the tissues. The solution should be absolutely free from dust and particles of foreign matter, and for the same reasons. The solution should not be too concentrated, primarily because concentrated solutions are *ipso facto* prone to irritate, and secondarily because the danger of overdosing is thereby increased. On the other hand, too great a dilution is unwise, because water in bulk is itself irritating and unnecessary. The strength of the solution will therefore vary with the solubility of the remedy. The reaction of the solution is important in the highest degree, for any pronounced acidity or alkalinity will necessarily and for chemical reasons prove irritating to the tissues, and precipitation, too, must often occur in acid solutions because of the alkalinity of the tissues. Neutral solutions are therefore to be employed, or at least solutions whose reactions are not more than to the slightest degree acid or alkaline. It is for these reasons that drugs which require considerable quantities of acids or alkalies to effect their solution are unfitted for subcutaneous use. An instance of this is seen in quinine, which, though indeed injected subcutaneously in acid solution, is injected perilously and often to the injury of the patient. (See under CINCHONA.) A question of much importance is that of the freshness of the solution employed. It is often the custom to make solutions for hypodermic medication and then to preserve them in bulk until the time arrives for their administration. This is highly objectionable, for in such solutions there develop fungi which render the liquids in every way unfitted for introduction among the tissues. The fungus most active in this way is the penicillium, a plant which thrives at the expense of the alkaloid which such solutions generally contain. The result of its action is to cause turbidity of the fluid and to render it in itself unsuited for employment, but its action is, furthermore, to diminish the alkaloidal strength and thus to render the solution doubly unsuitable. To prevent this decomposition there

have been added to hypodermic solutions a number of antiseptic drugs, especially boric acid, salicylic acid, and carbolic acid. Boric acid and salicylic acid, however, though active against the penicillium, are themselves irritants whose introduction into the tissues is not advisable. Carbolic acid is efficient and, if added to alkaloidal solutions in a proportion of not more than one minim to a drachm, is not likely to cause harm provided the amount of fluid injected is not sufficient to dangerously increase the dose of the acid. To be sure, the acid increases the temporary pain which is the first result of the injection, but this irritation is rapidly replaced by some local sedation and anæsthesia which are due to the well-known action of carbolic acid when locally applied. Furthermore, the antiseptic will perhaps have a tendency to minimize the irritation of the parts and the possibility of abscess formation. Distilled eucalyptus and cherry-laurel waters have been employed as solvents for hypodermic preparations, and certainly they seem to be efficient in preventing decomposition. There can be no question, however, that the wisest and best plan is to make the solutions fresh and as they are required, for then there can be no question as to decomposition. Formerly there was the valid objection to this practice that alkaloids whose hypodermic doses were in hundredths of a grain could not accurately be measured in quantities so small, but since the introduction of the preparation known as the tablet triturate this obstacle is removed, and we now have a reliable and accurate means of preparing our solutions extemporaneously.

A large number of drugs have been employed subcutaneously; in fact, those which have not been so given are the exception rather than the rule. Unfortunate results have often followed this inclusiveness, generally because the remedies used were not perfectly soluble in water or because they were themselves irritants. The agents which are especially appropriate for this method of administration are the alkaloids, for, because of their usual solubility and the smallness of their doses, they fulfil the requirements of the practice. Many of the alkaloids have been and may be used thus, but those which are especially to be recommended and which are most often used are morphine, atropine, strychnine, digitaline, physostigmine, hyoscyamine and hyoscine, coniine, pilocarpine, caffeine, apomorphine, cocaine, and ergotine. Agents other than alkaloids are in some instances proper for hypodermic injection, and alcohol, generally in the form of whisky or brandy, is eminently useful in conditions of *shock* and *collapse*, as is the similar employment of ether. Mercury and arsenic are thus given at times, but it must be confessed that the necessity of giving them subcutaneously is not apparent when we consider the disadvantages connected with the practice and the little urgency in the cases where they are ordinarily indicated. Quinine, as has already been said, is imperfectly soluble save in acid media, and therefore is doubly objectionable for subcutaneous use. In pernicious cases of malarial fever, however, haste is of course often necessary, and then the local objections must yield to the general urgent requirements. Quinine is therefore injected in acid solution. (See under CINCHONA.)

The advantages possessed by the hypodermic method are rapidity and certainty of action, the smallness of dose necessary, and the substitution which provides for a stomach which is incapacitated. The effects produced are far speedier than when the drug is given by mouth, and ordinarily are to some degree observable within a very few minutes. The full effect of the remedy is also accomplished thus, whereas otherwise it is not to be had, for in the case of drugs given by the stomach there is reason to believe not only that absorption is less complete than when they are injected beneath the skin, but that destruction of a portion of the remedy is caused by the digestive juices, with a natural diminution of the effect sought. For these reasons, too, a lesser dose suffices when the remedy is given subcutaneously. The value of hypodermic medication in conditions of gastric intolerance need not be dwelt on. Stimulation is often the essential where the stomach is least tolerant, and then it is that hypodermic stimulation may bridge the time until the stomach again becomes competent, and thus may settle the question of life or death.

Hypodermic medication, however, has its disadvantages, though they are many of them removable with care. The injection should be made into the subcutaneous connective tissue, from which it is absorbed by the circulation. Occasionally, however, the needle point enters the calibre of a vessel and the injection is made directly into the circulation. Under these circumstances the entire dose is hurled *en masse* at the nervous centres, with the result of causing sudden, intense, and sometimes fatal symptoms. At times the needle will pass through a vessel rather than simply enter it. In this case its removal leaves a traumatic passage from the injected material to the vessel, with the result that absorption, though less rapid than when the drug is injected immediately into the blood stream, is nevertheless sudden and the symptoms are often grave. The strict observance of the cautions laid down as to the syringe and the solution will do much to prevent another danger of hypodermotherapy—namely, abscess production—and what will presently be said of the performance of the injection will add more; but, in spite of all, abscess will sometimes result. This is a more frequent sequel in the debilitated, and in them the inflammation may be extensive and dangerous, even to the extent of gangrene. In many cases a true abscess indeed does not result, but for many days there is a brawny infiltration of the parts, which may be accompanied by much heat, redness, and tenderness. The inflammatory signs subside, and yet the induration may persist for a long time. In other cases induration alone is present from the time of the injection, and without inflammatory symptoms appearing at any time. This induration may indeed be persistent, almost without limit. The treatment

of local inflammation resulting from hypodermic injection is primarily abortive, and consists chiefly in the prolonged application of cold. If this fails, free incision and antiseptic dressing become necessary; but prophylaxis should be our chief effort, for an abscess resulting from a hypodermic injection must always be a source of mortification to the sensitive practitioner, even though it is not always avoidable. Tetanus, too, may occur as a result of subcutaneous injection, though, fortunately, it is an infrequent complication; and, finally, it must not be forgotten that disease may be transmitted from patient to patient by the needle, as it may by any other surgical instrument.

In giving a hypodermic injection a part of the body is selected which is free from large vessels, which is not likely to be exposed to subsequent irritation, and over which there is a sufficiency of soft tissues. Prominences are therefore to be avoided, and the deltoid region, the abdomen, the back, the buttocks, the flanks, the thighs, and the calves are the situations usually selected. The skin over the chosen area is thoroughly cleansed by washing with soap and water, with alcohol, and with some antiseptic solution. The syringe, scrupulously cleaned, is filled carefully, and all air bubbles are forced out by turning the syringe-needle up and slowly pressing the piston until the bubbles escape from the needle and only the solution flows out; the needle is thus filled with the solution as well. The dose is determined on, and, if the piston-rod is provided with a check, this is set to the required dose. The operator will then generally lift a fold of the skin and tissues between the fingers of one hand, while with the other he quickly inserts the needle into the fold, passing its point deep below the surface, lest if the injection is made superficially there shall be more injury to the delicate connections of the skin to its underlying tissues and more danger of subsequent inflammation. By some the needle is moved about a little before the injection is made, with the idea of breaking up the tissues to allow of the reception and absorption of the injected matter. This is scarcely necessary, and is certainly not free from the suspicion of causing subsequent mischief. If this moving the needle about is practised at all, it certainly should be done only to the slightest degree. The injection is now made, the needle withdrawn, and the wheal or swelling which follows the injection—whose cause is the fluid injected, and whose size therefore varies with its amount—is dissipated, and absorption is consequently promoted by gently rubbing the part. In all cases gentleness must accompany every step of the procedure; and where it is necessary to repeat the injection frequently it is wise to separate the points of insertion by considerable intervals, if not to distribute them in various parts of the body.

HENRY A. GRIFFIN.

HYPOPHOSPHITES owe their medicinal virtues chiefly to the phosphorus they contain and to their hypothetical contribution of that substance to diseased tissues. That such an action takes place is possible, but it certainly is not proved, and where phosphorus is needed phosphorus should be given and no dependence should be placed upon the hypophosphites. These salts, nevertheless, do seem possessed of some therapeutical value, though it must be confessed that it is usually a slight one, and yet in some cases of debilitating disease their employment is apparently productive of benefit. It is in *chronic pulmonary tuberculosis* that the hypophosphites have their greatest employment, and, though they certainly have not effected all that was expected of them when first they were employed, yet in some tubercular cases benefit appears to be derived from their use. Their use at the present time is more popular than professional; though physicians often employ them in pulmonary tuberculosis, they seldom do so to the exclusion of more trustworthy remedies. To the maker of proprietary medicines, however, their value appears unquestionable, and laity and physicians alike are daily informed of the value of this emulsion or that mixture, among whose active ingredients are "the hypophosphites of calcium, sodium, potassium, and iron." Conditions other than pulmonary tuberculosis have been thought benefited when thus treated, and these are in the main nutritional disorders. *Scrofula* is one of these, and the results of its treatment with the hypophosphites have been highly esteemed. *Bone diseases*, too, are thus treated, especially in case the patients are children. This practice certainly seems a reasonable one, particularly when calcium hypophosphite is employed, but, even so, no advantage exists over the use of calcium phosphate, and the practical results are scarcely more brilliant than when phosphorus itself is used, or even the calcium salts in general. In *disorders of the nerve-centres* the hypophosphites have had a considerable employment from their supposed action to yield phosphorus to the tissues which appeared to require it. No great value appears to reside in this use of hypophosphites, and certainly they possess no advantage over phosphorus itself. The hypophosphite of iron is tonic, as are all the iron preparations, but the especial advantage of this salt in anæmic conditions associated with impairment of the nerve-centres is certainly in need of proof. There is one application of the hypophosphites which, though quite empirical, is yet of considerable value, and that is in the treatment of *styes*, *furuncles*, and similar suppurative lesions. In such states the administration for a time of the syrup of hypophosphites with iron will often prove in the highest degree beneficial, both to abort the process and to prevent the repetition which is so commonly a feature in these cases.

Calcium hypophosphite, *calcii hypophosphis* (U. S. Ph., Br. Ph.), occurs in colourless, transparent crystals, or in lustrous scales, or in a white, crystalline powder. It is odourless, permanent in the air, and of bitter, disagreeable taste. Its formula is $Ca(PH_2O_2)_2$. It is soluble in water, but insoluble in alcohol.

The dose is from 10 to 30 grains. The soluble sulphates and carbonates are precipitated by calcium hypophosphite.

Ferric hypophosphite, *ferri hypophosphis* (U. S. Ph.), is a white or grayish-white powder, without odour, of little taste, and permanent in the air. It is only slightly soluble in water. Its formula is $Fe_2(PH_2O_2)_6$. The dose is from 5 to 10 grains, and it is usually given in the form of pill, powder, or syrup.

Potassium hypophosphite, *potassii hypophosphis* (U. S. Ph.), occurs in white, opaque crystals or crystalline masses or as a granular powder. It is without odour, of a pungent, saline taste, and very deliquescent. Its formula is KPH_2O_2. The dose is from 10 to 30 grains.

Sodium hypophosphite, *sodii hypophosphis* (U. S. Ph., Br. Ph.), appears in small, colourless, transparent, lustrous plates or in a granular powder. It is without odour, but has a bitterish and saline taste. It is very deliquescent in moist air. Its formula is $NaPH_2O_2$. The dose is from 10 to 30 grains.

Syrup of hypophosphites, *syrupus hypophosphitum* (U. S. Ph.), contains 45 parts of calcium hypophosphite, 15 of potassium hypophosphite, 15 of sodium hypophosphite, 2 of diluted hypophosphorous acid, 500 of sugar, 5 of spirit of lemon, and water enough to make 1,000 parts. The dose is from 1 to 2 fl. drachms. It is a desirable form in which to administer the hypophosphites.

Syrup of hypophosphites with iron, *syrupus hypophosphitum cum ferro* (U. S. Ph.), contains ferrous lactate and potassium citrate, 1 per cent. each, in syrup of hypophosphites. The dose is from 1 to 2 fl. drachms.

A syrup of the hypophosphites of calcium and sodium is sometimes employed, as is a syrup of calcium hypophosphite alone. Directions for making these are given in the *National Formulary*. The hypophosphites are incompatible with soluble salts of silver, copper, and mercury.—Henry A. Griffin.

HYPOPHOSPHOROUS ACID is official in the form of *acidum hypophosphorosum dilutum* (U. S. Ph.). This 10-per-cent. solution is given in doses of from 10 to 20 minims. For its indications, see Phosphorus.

HYPOSULPHITES are bases united with an acid of which the formula is theoretically $H_2S_2O_3$, but which on liberation is at once decomposed into sulphurous acid and sulphur. It is to this evolution of sulphurous acid that the hyposulphites as well as the sulphites and bisulphites owe their medicinal usefulness, for sulphurous acid is highly antagonistic to parasitic life, whether animal or vegetable, and therefore diseases which depend upon the presence of parasites may thus be treated with reason, provided, of course, that access of the acid to the parasite is possible and in sufficient amount. The employment of sulphurous acid itself, save in dilute solutions, is of course difficult because of its gaseous nature, and therefore the salts which will liberate it become useful, especially because of the unstable nature of these salts and the facility with which the liberation takes place. Although the sulphites and bisulphites are thus active as well as the hyposulphites, there seems to be some advantage in employing the last-named salts, for they are less likely than are the sulphites to absorb oxygen and thus to become transformed into sulphates.

The therapeutical employment of the hyposulphites is confined to cases in which their local application can be made, for, naturally, direct contact of the sulphurous acid with the parasite is necessary if the practice is to be successful. The local application of hyposulphites is often efficient for *cutaneous diseases of a parasitic nature*, such as *ringworm*, *pityriasis versicolor*, *scabies*, and *porrigo*. Inflammations of the mouth such as *thrush*, are also relieved. *Gastric fermentation* is benefited in the same way, for the action of the hyposulphites in that condition is a local one. To expect benefit from the administration of hyposulphites in *zymotic* and *septic diseases* is, however, unreasonable, for it is evident that a sufficiency of the remedy can not with safety be given to cause systemic disinfection, and attempts thus to treat these diseases have resulted only in failure.

Sodium hyposulphite, *sodii hyposulphis* (U. S. Ph.), *natrium thiosulfuricum* (Ger. Ph.), is also called sodium thiosulphate. It occurs in colourless, transparent crystals, without odour but of a bitter taste. It is very soluble in water, but insoluble in alcohol. Its formula is $Na_2S_2O_3 + 5H_2O$. The dose is from 10 to 20 grains. For external application, a solution is employed which usually contains 1 drachm of the salt to 1 oz. of water.

Other hyposulphites may be employed, since the remedial action of all of them is the same, but beyond the sodium salt none are official.

Henry A. Griffin.

ICE.—The use of ice internally is chiefly for the purposes of allaying thirst and nausea, and of soothing the throat in various painful conditions. For all these purposes ice broken into small fragments, the "Eispillen" of the Germans, may be employed. When it is used for its effect on the stomach, the pieces should be swallowed whole; when a local action on the throat is sought for, they may be allowed to dissolve slowly in the mouth. In almost all cases of nausea it is necessary to restrain the patient from swallowing the ice too freely, for the accumulation of water in the stomach would have a tendency to defeat the object in view.

Applied topically, ice acts partly by diminishing the amount of blood contained in the part, by virtue of stimulating the vaso-motor nerves. In this way it serves the purpose of relieving *superficial congestions* and *inflammations*, also that of facilitating the reduction of a *strangulated hernia*. It is usual to confine the ice, previously pounded into bits, in a bag. The ice bag should be waterproof and of light texture, so that it may not be unduly heavy.

A lump of ice is a ready application for the control of the capillary *hæmorrhage* that results from wounds of superficial parts, and the introduction of a piece of ice into the vagina has been found serviceable as a means of stopping *post-partum hæmorrhage* from the uterus, acting, no doubt, in a reflex manner. In severe cases it is not to be rated as of very great value, but may be resorted to as an expedient in an emergency.

Besides its action on the part to which it is immediately applied, ice appears to exert a soothing, sedative action on deep-seated organs; hence the ice bag is often of service in the early stages of acute inflammation of the internal organs, such as *meningitis*, cerebral or spinal, *encephalitis*, *myelitis*, *bronchitis*, *pneumonia*, *pleurisy*, *pericarditis*, *peritonitis*, *inflammations of the various abdominal* and *pelvic organs* or of the *connective tissue within the pelvis*, *epididymitis*, and *orchitis*. It may be said of the ice-bag treatment of deep-seated inflammations that it tends to relieve pain, although with some patients the sensation of cold produced by the ice is less bearable than the pain of the disease itself. Consequently, so far as the relief of pain is concerned, it is best not to insist on the use of ice when the patient finds it annoying; in many instances, if not in the majority, hot applications are more agreeable and quite as efficient.

The purely sedative action of cold, quite apart from its vaso-constringent action, may be brought into requisition to advantage in certain non-inflammatory affections, notably those dependent on "irritability" of portions of the central nervous system, or on disturbed action of the sympathetic nervous system. The application of ice to the spine has long been recognised as productive of important physiological results. Thus, years ago it was taught that it had a powerful influence in diminishing both the force and the frequency of the heart's action. "For this reason," said Todd to his pupils, "you must not apply it for too long a time or over too great an extent of surface; you must watch your patient and remove and reapply it as his condition shall indicate." Dr. John Chapman (*Lancet*, June 4, 1864) denied that "ice down the spine" had such an effect, and alleged that ice applied to the middle of the spine actually increased the strength and frequency of the heart's action. In the previous year Dr. Chapman had published a book giving his experience with the use of heat and cold applied to the spine, especially in certain functional diseases of women. These measures have not been found very valuable in the extensive range of diseases to which Dr. Chapman thought them applicable, but they are very efficient under some circumstances. The application of ice to the whole length of the spine has been found to be exceedingly serviceable in severe cases of *seasickness*, even those in which other remedies, such as chloroform, iced champagne, and effervescing waters, had been tried in vain (S. M. Bradley, *Lancet*, Dec. 3, 1864). Applied over the junction of the dorsal and lumbar portions of the spine, ice seems to have some effect in increasing the amount of blood circulating in the pelvic organs, and consequently to be of some service in *amenorrhœa* and *scanty menstruation*.

Quite recently a novel method of using ice as an *antipyretic* was described by Dr. P. Blaikie Smith, of Aberdeen (*Brit. Med. Jour.*, May 11, 1895). He calls the procedure "ice cradling." The subject, he said, had first attracted his attention about two years before, when Dr. W. Soltau Fenwick reported encouraging results following the adoption of certain antipyretic procedures in cases of *acute sthenic pneumonia*. Out of one hundred and eight cases treated by sponging or ice cradling the mortality had amounted to 10 per cent., while the death rate in five hundred and fifty-two cases treated in the ordinary way had reached 23 per cent. During the two months preceding his report Dr. Smith had had several cases of acute pneumonia in which his method of carrying out the treatment had been practically the same as that described by Dr. Fenwick. The patients were placed in bed, and over the body and legs two large cradles were arranged extending from the shoulders to the feet. Six or eight small pails filled with ice were attached to the arches of the cradles; a thermometer was hung from the centre of the upper cradle, and both the cradles were covered, first with a blanket, then with a waterproof, and lastly with the usual covering. The pails were refilled as the ice melted, and the temperature of the air under the cradles, of the ward, and of the patients was taken every four hours; the temperature of the air under the blankets before the cradles were placed in position was also taken. This treatment was maintained until the patient's temperature became normal. These cases, says Dr. Smith, were examples of acute sthenic pneumonia, all of them complicated with pleurisy, and in one instance the pneumonia was double. All the patients recovered.

With regard to the effect of the treatment on the bodily heat, says Dr. Smith, no marked depression was observed in one of two cases reported by him. The temperature declined gradually and in a somewhat fluctuating manner, the fall becoming more rapid as the crisis approached. The pulse- and respiration-rates, and their ratios to each other, seemed practically unaffected by the treatment.

In the other case the influence of the ice in this respect was more apparent, for with a temperature of 105° the pulse was only 100 and the respirations ranged between 30 and 35 a minute.

Dr. Smith states that he was unable to discover any marked signs of improvement following the complete establishment of the treatment. There was no sudden fall of temperature, but, although there was no decided reduction in the temperature, the pyrexia (even in one case where both lungs were extensively involved) did not attain a great height, and he is inclined to think that the treatment exercised a restraining influence on the bodily heat. The pulse and respiration also seemed to be under restraint, for the

heart's action was in no case unduly rapid or weak, and the breathing was never a source of anxiety. The patients, as a rule, felt comfortable under the treatment, although one or two complained of cold feet. In one patient inordinate perspiration was a marked feature, but the discomfort arising from this symptom disappeared at once with the establishment of the ice cradling.

Regarding the means by which the antipyretic results were brought about, the author thinks that a twofold influence was at work—that of the air under the cradles and that of the ice pails. It is doubtful, he says, which of the factors was the more powerful, although he inclines to the belief that the lowering of the temperature produced by the cradles was greater than that due to the melting of the ice.

Judging from what he has seen of the procedure, Dr. Smith is disposed to recommend ice cradling as a mild form of antipyretic treatment, suitable for sthenic cases of acute pneumonia, for it is easy of application, is not violent in its effects, is not fatiguing to the patient, and is readily carried out in any disease where a restraining influence on *pyrexia* and its attendant symptoms is desired.

ICELAND MOSS.—See Cetraria.

ICHTHYOCOLLA.—See Isinglass.

ICHTHYOL is a name which has been applied both to a crude oil obtained from certain bituminous rocky deposits found in mountainous regions of the Tyrol, and also to the product of the action of concentrated sulphuric acid upon this oil. It is the latter only which is used in medicine. The bituminous rock from which the crude oil is extracted is found in the neighbourhood of Seefeld, occurring in veins or strata varying in thickness, as well as in the amount of bitumen contained from 10 to 20 per cent. The rock may be either shaly or porous and spongy, or compact and hard like limestone. Where it occurs there are found numerous fossil impressions of fishes as well as many petrified fishes. From these indications, and others more general in character derived from the rock conformation, it is conjectured that the bituminous deposit, notwithstanding the fact that it now lies five thousand feet above the sea level, is the product of organic remains of prehistoric fishes and other marine animals imprisoned there in some past age before the rocks had emerged from the sea, which, as is well known, once reached to the foot of the Alps. This conjecture has been further corroborated by finding in the bitumen the bases of bone tar-oil. From this supposed origin is the name ichthyol derived.

To obtain the crude oil the rock is subjected to dry distillation in iron retorts of peculiar construction, the resulting product being a tar-like mass of a peculiar penetrating and disagreeable odour. After long standing this mass separates spontaneously into a very thick pitch-like substance and a thin dark oil. The latter is then purified and rectified, and thus the remaining tarry matter is removed, leaving a clear oil to which the peculiar odour is found to belong. It differs decidedly from other mineral oils, not only in its odour, but also in the large proportion of sulphur which it contains, which is in such close chemical union with the other components as not to be separable from the oil without the latter being totally destroyed. The oil is further characterized by a sea-green fluorescence. When this crude oil is treated with concentrated sulphuric acid it becomes heated sometimes to 100° C. (212° F.), and the acid is taken up by the oil in considerable quantity with the development of much sulphurous acid. Thereby is formed a sulpho-acid, an ichthyolsulphonic acid. After it has been freed from the superfluous sulphuric and sulphurous acids and combined with a base, usually ammonium or sodium, a notable change in colour takes place as well as in the odour, which latter is wholly different from that of the crude oil. It is bituminous and empyreumatic in character. This prepared substance, to which the name ichthyol is most commonly applied, is a thick, tar-like liquid, of a dark-brown colour, which when thoroughly refined is perfectly soluble in water, and also in equal parts of alcohol and ether. The chemical formula for the sodium compound is $C_{28}H_{36}S_3Na_2O_6$. Ichthyol is therefore a salt formed from a dibasic acid—a sulphoichthyolate (or ichthyolsulphonate) of sodium or ammonium as the case may be. Zinc and lithium salts have also been formed.

Ichthyol is chiefly remarkable for the large proportion of sulphur it contains, a larger proportion than that found in the crude oil. It is nevertheless but slightly irritating to the skin, much less so than an ointment containing a like amount of sulphur would be. Moreover, it may be combined with preparations of lead and mercury without producing black sulphides. To the contained sulphur it doubtless owes its property as a reducing agent—the property to which its therapeutic virtues are mainly ascribed, and which has suggested its use in a wide range of diseases, both internal and external. The most exhaustive investigation of its various applications has been made by Unna, of Hamburg.

Upon the external integument the action of ichthyol especially concerns the process of cornification, which, as is well known, involves a process of deoxidation. The effect of mild applications on the intact horny layer is to render it thicker, denser, and harder. If the application is continued for some time a division in the horny layer takes place into an upper, dark-coloured, loosened layer (that part which has been thoroughly permeated by the drug) and a deeper, clear layer which has been newly formed under the influence of the application from the uppermost layer of the prickle cells, an artificial cornification due to the reducing process. To the same process is due the discoloration of the upper layer in the same manner, though less in degree, as from the use of chrysarobin. An occasional incidental effect of the application to the skin is the production of pustulation, which is attributed chiefly to the overproduction of horn cells

in the follicles, impeding the escape of pus germs that are accidentally present.

On the superficial blood-vessels the effect of the mild action is to cause contraction and diminution of their calibre through condensation of the endothelium, thereby tending to counteract *hyperœmia* and the effects of *inflammation*, heat, redness, and swelling, eventually also diminishing pain. Similar effects, it is alleged, are produced by the internal action of the drug. When, on the other hand, the action is excessive, especially where ichthyol has been applied strong to places where the skin is thin, as upon the eyelids, an opposite effect may result, with redness and swelling.

The horny layer is affected alike by mild and by strong applications. But on the rete the latter tend to produce softening and degeneration. Vesicles and bullæ may form with a thick horny layer above. Through the strong action the blood-vessels suffer injury, and exudations occur. On the collagenous framework of the cutis the effect is to cause softening and resorption, an effect which may be of service to reduce the thickenings of *old eczemas*, *scleroderma*, and *elephantiasis*, and also, it is maintained, in the *scars of variola*, *acne*, and *keloid*. (Unna.)

In *burns* of the first grade, or of the second grade so long as the blisters are small and intact, strong applications of ichthyol have been found of great benefit, allaying the pain, reducing the congestion, and often, when early applied, preventing vesiculation and thus retaining at the first grade what otherwise would be a burn of the second grade. In this case, though the application to the surface is a strong one, the action that reaches the rete and vascular layer is mild, and only the primary effect is produced. If, however, the surface is eroded and the swollen prickle cells are exposed, a strong application causes irritation and catarrhal inflammation. The effect is not the same, however, upon a clean-cut surface or *incised wound*. Here an application of the pure ichthyol will, it is said, cause the surfaces to adhere and unite by first intention.

In *erysipelas* ichthyol has been used quite extensively, and the testimony to its value in this disease is abundant. In many cases its effect is quite remarkable, reducing congestion, tension, swelling, and pain, and apparently limiting the progress of the disease. The stronger applications, where the skin is thick and the epidermis intact, are the most effective. The remedy may be used either in salve or superfatted soap, in strengths varying from 2 to 50 per cent., in watery solution, or in the form of a spray of a solution in alcohol and ether, or, finally, in salve- or plaster-muslins. On the lower extremities the following may be applied, as recommended by Unna:

℞ Ammonium sulphoichthyolate,
Ethereal spirit (spiritus æthereus [Ger. Ph.]), each...... 10 parts;
Collodion .... 20 "

In erysipelatoid affections (the *erysipeloid* of Rosenbach) the remedy is equally serviceable, though requiring less strong applications.

Its use both internally and externally is recommended in *rosacea*. The digestive derangements that commonly accompany this affection furnish the chief indication for its internal use, and it is maintained by Unna that some direct (reducing) effect is exerted in this way upon the disordered cutaneous circulation. Externally, the milder applications are recommended for such forms as simulate eczema and erythema, while for the papular and pustular varieties the stronger applications are advised. For *intertrigo* a 10-per-cent. salve or superfatted soap is used, or the watery solution. In *eczema marginatum* similar applications, to which from 2 to 10 per cent. of salicylic acid is added, are said to be useful.

In *nervous eczemas* ichthyol is much lauded by Unna. In this form the eczema is apt to be in discrete patches with papular or vesicular lesions, without much impairment of the horny layer, so that a comparatively strong application will be borne. It is advised, however, that after a few days the strength be diminished, the continuance of the stronger preparations being apt after a time to irritate, so that unless it is reduced in strength the good effect will be annulled. In the nervous form of eczema, especially in children, the remedy should, it is said, be used not only externally but internally also. From 5 to 10 drops may be given to children, in wine or beer, and continued for long periods. The patients are said to soon acquire not only tolerance of the taste, but even a liking for it.

In *parasitic eczemas*, though ichthyol is but a feeble germicide, it nevertheless is a useful remedy, inasmuch as through its power of abstracting oxygen it may tend to sterilize the part, both by a certain asphyxiating effect upon the germs and by its promotion of a solid horny growth which would serve to bar further parasitic invasion. As an adjunct to stronger antiparasitics or to other anticatarrhal substances, it is a remedy of no little value in various diseases of a parasitic nature. In the following formula of Unna's, recommended more particularly for *lupus*, the ichthyol serves to counteract the keratolytic effect of the bichloride of mercury:

℞ Hydrarg. chlorid. corros. 1 to 4 parts;
Sodii sulphoichthyolat.. 5 to 10 "
Aquæ dest.......q. s. ad 100 "

To the value of ichthyol as a *discutient* agent for *inflammatory indurations* or *deposits* considerable testimony has been advanced. It is recommended for *old inflammatory thickenings of the skin*, for *swollen glands*, for *rheumatic joints*, and as an injection in *hydrocele*. Local applications of it in the *arthritis* of gout and rheumatism are said often to give considerable relief to pain and to reduce inflammation. Unna has reported rather remarkable effects in a case of *lepra* from the use of sulphoichthyolate of ammonium, used both externally and internally. Applications were made varying in strength from 10 to 60 per cent., and doses increased from 10 to 15 drops a day were given internally for a long period.

In *gonorrhœa* a watery solution of from 1 to

5 per cent. has been recommended as an injection.

In the administration of the drug the preparation most commonly employed, whether for internal or external use, is the sulphoichthyolate of ammonium. Internally, the usual dose is 5 minims, three times a day, given either in pill or in capsule. For external use a watery solution may be used, a solution in alcohol, in ether, or in vaseline or some other ointment base. To disguise the odour it is recommended to add a few drops of an alcoholic solution of equal parts of cumarin and vaseline. Cologne water answers also very well as a menstruum. An ichthyol varnish, virnisium ichthyoli, recommended by Unna, will be found very useful for application to the skin over limited areas of disease. It is made by mixing 40 parts of starch with 20 of water, then adding 40 of ichthyol, and from 1 to 1½ of fresh albumin. It dries very rapidly and remains dry afterward, but can be readily washed off with water at any time. Another formula is given by Unna for an antiseptic dressing in minor surgery and in parasitic affections. It is known as *virnisium ichthyoli carbolisatum*, and consists of 25 parts of ichthyol, 2½ of carbolic acid, 50 of starch, and 22½ of water. To these varnishes other reducing substances, such as chrysarobin, may be added, provided always this added substance is first mixed with an equal quantity of water or, better, linseed oil.

[Dr. L. Guido Scarpa (*Therap. Woch.*, 1895, No. 17; *Am. Jour. of the Med. Sci.*, Aug., 1895) has used ammonium sulphichthyolate in various diseases with excellent results. After a year's experience with it he says that the drug not only has a reducing action upon tissues, rendering them anæmic, contracting the bloodvessels, and acting as an *antiphlogistic* and even as an *analgetic*, but also that as an *antiseptic* it has a direct influence upon pathogenic bacteria, especially upon the streptococcus and diphtheria bacillus, to a lesser degree upon the *Bacillus pyocyaneus*, and the *typhus*, *cholera*, and *malignant pustule* bacilli. It is also a conservator of tissue waste, and can be borne in large doses by the alimentary tract. From the 150 cases under observation, in which the drug was used in solution (1 to 3) in water, glycerin, rectified alcohol, or oil of peppermint, the last being used to conceal the disagreeable odour, the results were encouraging. Of this mixture from 20 to 200 drops were taken each day well diluted in water, 10 to 15 oz.

Ichthyol has been found to be of great service in gynæcological practice. Its use in gynæcology, says Dr. Malcolm Storer in an excellent article on the subject (*Boston Med. and Surg. Jour.*, Aug. 2, 1894), was first suggested by Freund, in 1890. Freund had observed very rapid and complete cures in many cases of *chronic parametritis*, *chronic* and *subacute perimetritis*, with exudation and adhesions, *cicatricial atrophy of the vagina* and *cervix uteri*, *chronic metritis*, and *salpingo-oophoritis*. He had also found it valuable in the treatment of *pruritus* and of *cracked nipples*. He had observed an extraordinary *sorbefacient* and *analgetic* power in ichthyol.

Other investigators, says Dr. Storer, admit its analgetic qualities, but deny that it promotes absorption. Reitmann and Schönauer have reported the most gratifying results with regard to *pain* in a hundred cases of *inflammation*. Bloch was the first to apply pure ichthyol to the endometrium, and was convinced of its resorbent as well as of its anodyne action. He noticed great improvement in cases of *acute elytritis* and *chronic metritis* with venous engorgement. That its effects were not due to the use of a glycerin solution he proved by a series of experiments with pure ichthyol, and stated his belief that the pure drug was more efficient than the glycerin solution. Kötschau employed ichthyol in fifty-six cases of *endotrachelitis*, also in a hundred and twenty-seven cases of *endometritis*, using also, in the severer cases, a preliminary curetting, also iron, massage, and douches. Although treatment with other means gives about the same proportion of cures, Kötschau, says Dr. Storer, regards that with ichthyol as much safer. In fifty-two cases of *febrile perimetritis* he employed tampons of ichthyol-glycerin with ichthyol pills and hot sitz baths, and was satisfied that this treatment produced a cure more promptly than any other, the pain being often relieved by the first application and the exudate quickly disappearing.

In a number of cases of moderately *acute pelvic inflammation* with much pain, but where an operation did not seem to be indicated, Dr. Storer has employed the following method: Every third day, after carefully drying the vagina, its vault was freely painted with ichthyol-glycerin, or with pure ichthyol, followed by the introduction of a pad soaked in the solution, which in turn was guarded by a dry pad. In addition to this, full hot douches were sometimes employed. In perhaps a dozen cases pills were given. No discomfort from them was noticed, except in one or two cases of dyspepsia, when the patients complained of the taste of the eructations. On the other hand, the author can not say that any of the patients taking the pills seemed materially better. In nearly all the appetite improved, but this he thinks may have been due to the improvement in the general condition. In six cases of deep-seated pelvic pain the ointment was tried, and possibly the very slight but positive relief that was observed may, says Dr. Storer, have been due to massage. In this class of cases he can only say that the patients seemed to improve faster than where other methods were employed. The relief to sharp pain was fairly constant and immediate, and in a few cases a single application gave almost entire relief. Dull, aching pain was not so easily reached, although it was the exception if relief was not experienced after a number of applications.

In cases of *chronic endometritis* seen by Dr. Storer at comparatively long intervals pure ichthyol was applied to the fundus after a preliminary partial disinfection with lysol or creolin, and the relief from local pain and

dragging was constant, and generally there was in a short time much less *leucorrhœa*. Of course, says Dr. Storer, very many obstinate cases finally came to curetting, but his impression is that as many, if not more, were cured or relieved by this method than by any other treatment. He has used the salve and the pure drug in a number of cases of *pruritus of the vulva* and of the *anus*, and there was improvement in all, but no cure. In a few cases of painful *hæmorrhoids* it seemed to relieve the discomfort by lessening the congestion. From what he has seen, Dr. Storer feels justified in drawing the following conclusions: 1. Although ichthyol is by no means the gynæcological panacea that some observers have held it to be, still it has sufficient approved value to deserve a very high place in our list of remedies. 2. While its chief action is to relieve pain, it does possess certain resorbent qualities, which in some cases are relatively powerful. 3. Its use is unattended with danger or discomfort. 4. The pure drug is generally more satisfactory and reliable than solutions. 5. It has not yet been proved that it has any gynæcological value other than as a local application.

Dr. Van der Willigen (*Nederl. Tijdschr. v. Geneeskunde; Ctrlbl. f. Gynäkol.*, May 4, 1895) reports four cases of *fissure of the anus* in which healing took place speedily under the application of pure ichthyol. The drug was applied every morning and evening, also after each defecation, by means of a pencil introduced into the anus, and rubbed into the parts with a little pressure. He further recommends ichthyol in the treatment of *fissure of the vagina*, of the *lips*, of the *ears*, and of the *hands*.]—Edward B. Bronson.

IGNATIA, or *bean of St. Ignatius*, is the seed of *Strychnos Ignatii*, a tree that is indigenous to the Philippine Islands, where the seeds were used by the natives as a medicine. The Jesuit missionaries named it in honour of the founder of their order. The seeds have been analyzed by Flückiger and by A. Meyer, who have found that they closely resemble nux vomica, although they yield a larger proportion of strychnine, brucine, and igasuric acid. Formerly ignatia was the principal source of commercial strychnine, but nux vomica has supplanted it as the source of that alkaloid.

Like strychnine, ignatia increases the reflex functions of the spinal cord and arrests respiration by a tetanic spasm of the muscles. It possesses similar physiological properties to those of strychnine, which is the preferable medicament.

Tincture of ignatia, *tinctura ignatiæ* (not now official), may be used in lieu of tincture of nux vomica, in doses of from 1 to 15 minims. Ignatia may be administered in all diseases in which nux vomica is indicated.

Samuel T. Armstrong.

IGNIPUNCTURE is a method of treatment in which punctures are made into tissues with a more or less pointed cautery. Ignipuncture may be employed to produce local counter-irritation or for the destruction of tissue. The surface should be cleansed with a 2½-per-cent. solution of carbolic acid and then dried and a cocaine solution applied superficially to a mucous membrane or hypodermically in the case of the skin. The cautery should be heated to a white heat, and carefully pressed into the tissues to such depth as may be essential to produce the required effect. Subsequently the external surface may be covered with a dry or moist dressing, and a mucous membrane should be irrigated once or twice daily with some antiseptic solution until the burned tissue has been absorbed or has sloughed away and granulation and cicatrization have taken place.

St. Germain and others have found ignipuncture with a compressed loop heated to redness a valuable agent in *chronic hypertrophy of the tonsils* in children. The wire is forced into the mouths of the distended crypts to a depth of a centimetre, from three to four crypts being treated at each operation, and the procedure is repeated once or twice a week, according to the reaction.

In *petit mal* the point of a Paquelin cautery may be applied upon the skin in the region of the nucha. This application was used by Charcot in *neuralgias* and other neuroses in which counter-irritation was required, and it was called by him intradermic ignipuncture.

Guillaud found this method of treatment useful in *synovial cysts;* Chalot recommended it for *fungous arthritis;* F. Randone used it for prophylactic and curative purposes in *chronic articular inflammations* of all kinds. P. Koch and others have used it in *hypertrophy of the tissues of the nose.*

Samuel T. Armstrong.

ILLICIUM (U. S. Ph.), *anisi stellati fructus* (Br. Ph.), star-anise, is the fruit of *Illicium verum* (or *anisatum*). Star-anise is *stomachic* and *carminative*. It is but little used except as a flavour. The dose of the volatile oil, *oleum anisi* (Br. Ph., which defines it as "the oil distilled in Europe from anise fruit, or in China from star-anise fruit"), is from 1 to 4 minims.

INDIA RUBBER.—See Rubber.

INFILTRATION ANÆSTHESIA.—This method of inducing local anæsthesia was devised by Dr. C. L. Schleich, of Berlin, who brought it before the Congress of German Surgeons in 1894. Dr. O. Bloch (*Australasian Med. Gaz.*, June 15, 1895), who has tested it in more than twelve cases, says that it is based on the principle of establishing a local œdema in whatever tissue and at whatever depth the knife may have to work in. The liquid used is a 0·2-per-cent. solution of ordinary table salt, to which is added a minimum of some narcotic, such as cocaine, morphine, or codeine, in a proportion far too small to be dangerous, even though large quantities of the fluid should be injected. If a certain area of any tissue, says Dr. Bloch, is thoroughly infiltrated with a 0·2-per-cent. salt solution it becomes anæsthetic, in consequence partly of the specific action of the solution on the nerve tissue, partly

in consequence of the combined effects of the ischæmia, compression, and local decrease of temperature produced in the œdematous area. The cooler the injected fluid is, the more effective it is. Schleich uses three solutions in which the 0·2-per-cent. chloride-of-sodium solution is combined with cocaine and morphine (or codeine) in various degrees of strength; the slight addition of carbolic acid is made to keep them aseptic.

SOLUTION.	I.	II.	III.	In English Measure. I.	II.	III.
Cocaine hydrochloride........	0·2 grm.	0·1	0·001	4 grs.	2	$\frac{1}{5}$
Morphine hydrochloride........	0·025	0·025	0·005	$\frac{1}{2}$ "	$\frac{1}{2}$	$\frac{1}{10}$
Sodium chloride..	0·2	0·2	0·2	4 "	4	4
Sterilized distilled water..........	100 grm.			4 fl. oz.		

Add three drops of a 5-per-cent. solution of carbolic acid.

The table salt ought to be heated and the distilled water boiled before making up the solution, to insure asepsis.

The solution No. 2 is the one generally used; No. 1 may be used in much inflamed tissues. No. 3 is very often sufficient and especially useful in protracted operations, when, by using No. 2, the maximum dose of the narcotics would be approached. About 2 fl. oz., or fifty Pravaz syringefuls of twenty minims each of No. 2, or 20 fl. oz., equal to five hundred syringefuls of No. 3, may be injected before the maximum dose of cocaine (or morphine) is reached, and practically even double the quantity would still be without danger, for the whole amount is not injected at once, but in minute quantities at a time, and at least half or two thirds of the injected fluid is washed away by the blood or oozes out from the wounds without being absorbed into the system.

Every operation, says Dr. Bloch, has to begin with the establishment of an œdematous spot within the layers of healthy skin in the vicinity of the place to be operated upon. The needle of a Pravaz syringe is filled with one of the solutions and inserted into, not underneath, the skin, superficially and as much as possible parallel to the surface, just far enough to bury the slit of the needle. By gentle pressure sufficient fluid is driven out to cause a white œdematous spot, a sort of wheal, to arise. Within this spot the tissue is perfectly anæsthetic. By inserting the needle again into the first wheal, near its periphery, a second wheal is established, and so on, until a line of wheals has been formed corresponding to the extent and course of the incision to be made. Only the first insertion of the needle, says Dr. Bloch, is accompanied with the slight pain of a prick; all the subsequent punctures are perfectly painless, being made within the area of anæsthesia previously established. Along this line of wheals the skin is incised right into the subcutaneous tissue. If it is necessary to cut deeper than through the skin, the subcutaneous tissue is infiltrated in exactly the same way, care being taken that every injection is made within the area of tissue already infiltrated. In securing bleeding vessels it may be necessary, after gently pressing them between the branches of the artery forceps, to infiltrate the sheath of the vessel before ligating it, or to touch it with a drop of concentrated carbolic acid, to deaden the sensibility of the fine nerves of the coat of the blood-vessels. Every tissue, says Dr. Bloch, whatever its nature may be, may be infiltrated and rendered anæsthetic; it can be done easily and with little waste of solution in the soft tissues (subcutaneous, muscular, fatty), with greater difficulty and under considerable pressure in sclerotic ones. Even bone, he adds, can be rendered perfectly anæsthetic by the infiltration of the periosteum. If the stratum within which the operation has to be performed is not too deep, the infiltration can be carried on to it by simply pushing the needle, with continuous expression of fluid, deeper and deeper; or we can infiltrate layer after layer, keeping the margins of the superficial ones apart with sharp or blunt hooks. The time during which the anæsthesia will last, says Dr. Bloch, may safely be supposed to be from twenty to twenty-five minutes, but nothing, he remarks, prevents any layer from being reinjected as often as can be done without exceeding the maximum dose of the narcotic.

Dr. Weller Van Hook, of Chicago (*Med. News*, Nov. 16, 1895), reports his satisfactory experience with Schleich's method. He states that several simple but important points must be borne in mind in order to insure success under special circumstances. Of these, he says, probably the most important is that inflamed tissues are supersensitive, and must not themselves be infiltrated until the neighbouring normal tissues have been anæsthetized. For example, to inject fluid into the apex of a furuncle without preparation would be a cruelly painful procedure; but if the operator carefully anæsthetizes the skin all around the boil before infiltrating the inflamed structures, he will be able to open the suppurating focus absolutely without pain. Schleich, says Dr. Van Hook, is in the habit of advancing upon such abscesses from two foci upon opposite sides of the seat of infection.

INFUSION.—See under Transfusion.

INFUSIONS, *infusa* (U. S. Ph., Br. Ph., Ger. Ph.), are solutions of those portions of crude vegetable drugs which are soluble in the menstruum used. The menstruum is usually water, and, though it is permissible, and in some cases necessary, to employ it cold, it is generally heated to the boiling point and poured upon the drug, after which the mixture is allowed to stand in a covered vessel for a variable time and subsequently strained. This constitutes the process used in domestic practice, as well as that of some pharmacopæias; but infusions prepared under the official directions of the U. S. Ph. are diluted with cold water, after the straining has been done, until a required strength has been reached. Actual boiling in the preparation is not allowable; otherwise the product would be not an infusion, but a decoction. The amount of heat required and the length of time the

maceration is to be continued will vary with circumstances. In general, it may be said that water of considerable heat will extract the soluble principles from vegetable drugs more rapidly and in larger amount than water of a lower temperature, and, moreover, will dissolve some principles which are almost or quite insoluble in cold water. On the other hand, cold water is the preferable menstruum when the active principle of the drug is altered or dissipated by heat or when the drug contains some injurious matter whose extraction will be less likely from the action of cold water than from that of hot; the process with cold water, however, is necessarily a long one. Infusion when done with hot water should generally be continued until the water has become cooled by standing. In some cases, because of slowness of extraction, the warmth of the water must be artificially maintained, but only to a moderate degree, boiling of course being forbidden. Percolation is the process by which stronger infusions are prepared, and various forms of infusion jars are in use which act by this means. The water with which infusions are prepared should be as pure as possible, lest turbidity and even alteration of the infusion result. The substance to be infused is ordinarily coarsely divided or bruised, but in case of percolation it is powdered.

The advantages of infusions are several. By means of them the fresh remedy may be given more conveniently than in bulk; not that the infusion is the exact equivalent of the crude drug—on the contrary, it represents usually but a portion of its composition and generally of its activity—but this is as often an advantage as it is a disadvantage. To be sure, freshness is not always an important or even a desirable quality of vegetable drugs, but in some cases it is, and here infusions are useful. They are more apt than decoctions to be desirable in such cases, because, while the latter no doubt represent some of the valuable properties of the fresh drug, they are less likely to do so than infusions are, on account of the chemical changes which ebullition involves. Of more value perhaps than freshness in the action of infusions is the bulk of liquid, for water itself has therapeutic properties, and this fact largely explains the value of infusions as *diuretics* and *diaphoretics*, especially when they are given hot. As *emetics*, too, infusions are often useful, not only because of their medicinal ingredients, which are generally bitter and even nauseant, but because when given for the purpose of causing emesis they are administered warm and in considerable amount, and warm water itself thus employed is emetic. Infusions, then, are preparations of much usefulness, and, though the day of their extensive employment in domestic practice is perhaps now passed, this is not altogether a reason for congratulation, for the lay administration of an infusion of some harmless remedy, such as anthemis, in *colds*, *indigestion*, and *febricula*, was often, and by virtue of emesis, diaphoresis, and diuresis, a therapeutic procedure of great service. As *bitters*, too, infusions are useful when given cold, but this use of them is of lesser value than the others I have mentioned, and in general the giving of a bitter of less bulk is to be preferred, because of the disagreeable nature of the dose and its tendency to vomit. The use of infusions by the profession has grown less of recent years, and the preferences seem now for active principles, alkaloids, and glucosides, remedies of intensity, of violence, and therefore of minuteness of dose. These are useful and invaluable in their way, but I venture to think that the neglect of the infusion and the decoction which they imply is not altogether wise, provided the infusion and the decoction are in truth preparations of fresh drugs and not pharmaceutical imitations and substitutes.

The usefulness of infusions seems to have official recognition, for, apart from the official infusions, the pharmacopœias give general directions by which infusions of any appropriate substance may properly be prepared. The U. S. and Ger. Ph's give these directions under the heading of *infusa*. The directions of the U. S. Ph. are to the effect that an ordinary infusion, the strength of which is not directed by the physician or specified by the Pharmacopœia, shall be prepared by the following formula: Take of the substance, coarsely comminuted, 50 grammes; of boiling water, 1,000 cubic centimetres; of water, a sufficient quantity to make 1,000 cubic centimetres. Put the substance into a suitable vessel provided with a cover, pour upon it the boiling water, cover the vessel tightly, and let it stand for half an hour. Then strain, and pass enough water through the strainer to make the infusion measure 1,000 cubic centimetres. To these directions is added: "Caution.—The strength of infusions of energetic or powerful substances should be specially prescribed by the physician." Similar provisions are laid down by the Ger. Ph., but here the amount of the substance is placed at 1 part in 10 parts of the infusion.—Henry A. Griffin.

INGLUVIN.—This is an American preparation made from the gizzard of the domestic fowl and said to contain a digestive principle superior in some respects to pepsin. Investigators have declared themselves unable to detect such a principle in ingluvin, but favourable reports of the use of the drug in *dyspepsia* and the *vomiting of pregnancy*. In dyspepsia 7 or 8 grains may be given three times a day after eating; in the vomiting of pregnancy, the same amount half an hour before eating.

INHALANTS, INHALATION.—Inhalation, the utilization of the normal act of inspiration to convey medicaments into the air-passages, is usually practised for local effect, less often for systemic effect.

Inhalants or the remedies used by inhalation may be divided into (1) gases, vapours, and fumes; (2) liquids and solutions of gases and solids; (3) solids in the form of powder. The number of remedies that may be so employed is thus seen to be very great. The method of administration will vary with the physical characteristics of the remedy. For de-

scription of instruments employed the reader is referred to special treatises or manufacturers' catalogues. Gases, vapours, and fumes may be allowed to diffuse in the air of an apartment or be conveyed by some suitable contrivance—from a generator or reservoir—directly to the air-passages. Liquids are propelled by a current of air (or other gas) through tubes so arranged as to break them up into sprays or nebulæ. Powders are either insufflated (see INSUFFLATION) or kept stirred up in a kind of cloud that may be drawn into the respiratory tract with the inspired air.

Gases, Vapours, and Fumes.—The principal gases medicinally inhaled are *air* at modified pressures and temperatures, *oxygen, ozone, nitrogen monoxide, carbon dioxide* and some *hydrocarbons, sulphurous acid, hydrofluoric acid,* and *chlorine.* The principal vapours are *steam, ether, chloroform, ethyl iodide, amyl nitrite, iodine, creosote, carbolic acid, camphor, menthol, benzoin, eucalyptol, terebene, ammonia, nascent ammonium chloride,* and those arising from decoctions of aromatic, resinous, and narcotic plants. The principal fumes are those from *tar, mercury, sulphur, arsenic, nitre, stramonium, belladonna, cubeb, tea, tobacco,* and *opium.*

Oxygen (*q. v.*) is usually stored under great pressure in stout metallic cylinders, from which it is drawn as needed into a rubber bag, from which in turn it is passed through a wash bottle into a tube terminating in mouthpiece, nosepiece, or face mask, the latter usually being provided with a valve for expiration. Sometimes it is inhaled directly from the bag, sometimes it is passed directly from the cylinder through the wash bottle. Many physicians prefer recently-prepared oxygen. Its principal therapeutic uses are in conditions of *temporary obstruction of the air-passages* or diminution of the active pulmonary surface (as in croup and acute pneumonia), in attempts at resuscitation, in cases of *narcotic poisoning,* in connection with ether and chloroform in the production of anæsthesia, and in bringing about recovery from ether and chloroform anæsthesia or narcosis.

Carbon dioxide (*q. v.*) is liquefied and stored in cylinders or may be freshly made and collected in rubber bags. For purposes of inhalation it is to be diluted with air or oxygen, the proportion of CO_2 varying from 1 to 10 to 1 to 3, according to the susceptibility of the patient. It has been found to relieve cough, promote sleep, and reduce hectic temperature in cases of *pulmonary tuberculosis.* It has also been of palliative service in a few cases of *spasmodic asthma* and of *pertussis.*

Hydrocarbon mixtures, such as are to be found at the works where illuminating gas is made from coal, have a certain reputation in *pertussis.* As children are usually sent to the gas house where various gases and vapours are diffused in the atmosphere, it is difficult to say what, if any, is the remedial agent. Any form of illuminating gas inhaled undiluted would produce death.

Hydrogen, pure or diluted in various proportions with air and oxygen, was employed by Beddoes as an *antipyretic* and *sedative* agent in the late stages of *pulmonary tuberculosis,* and seems to have been beneficial. Recent reported experience is lacking.

Hydrogen sulphide, diluted with oxygen, has been employed as a *pulmonary disinfectant.* It is disagreeable and dangerous.

Hydrofluoric acid has been employed with apparent advantage in the treatment of *pulmonary tuberculosis.* The method of Garcin is to place patients for an hour daily in a cabinet of 6 cubic metres' capacity, into which he forces air previously saturated with the gas by passing through a solution of 1 part of hydrofluoric acid to 3 parts of distilled water contained in a rubber bottle.

Sulphurous-acid gas may be allowed to diffuse thoroughly in the air of a special chamber or ordinary apartment, into which a patient may then enter and remain for an hour, more or less. The quantity of gas diffused must depend on the patient's tolerance.

The *Pictet liquid,* which consists of sulphurous anhydride and carbon dioxide liquefied by pressure, may be employed; or a mixture of flowers of sulphur 10 parts, slightly moistened with alcohol, and charcoal 1 part, may be burned in an open vessel. Dujardin-Beaumetz burned in a closed room 150 grains of sulphur for every cubic yard of space, and twelve hours later had the patient enter the room and remain for four hours. Kircher recommends that patients shall remain in a room where hourly 1 or 2 drachms of sulphur are vapourized on a warm stove. Some of the irritating effects of sulphur fumes may be mitigated by burning, at the same time, opium and gum benzoin. The agent is used as an *antiseptic* in *pertussis, infectious anginæ,* and *pulmonary tuberculosis.*

Chlorine undiluted is irrespirable. It is a powerful disinfectant. Its principal use is in *pulmonary tuberculosis* and *bronchorrhœa.* It may be evolved in proper dilution for direct inhalation by mixing 1 or 2 drachms of chlorine water with 2 oz. of hot water and placing the vessel in a hot bath or over a flame; or it may be diffused through the air of an apartment by allowing a saturated solution of chlorinated lime to drip upon diluted sulphuric acid in Corrigan's apparatus or some more modern generator. Dr. Shurly, of Detroit, diffuses a spray of (saturated) sodium-chloride solution through a small room in which chlorine gas is afterward evolved in the proportion of from 1 to 4,000 to 1 to 20,000 of the air contents. The diffusion of spray and gas being complete, the patient enters and remains at first for ten minutes, later for half an hour or longer, the spray of sodium chloride being continued. The patient is directed to keep the mouth closed and breathe through the nose. This method is applicable to cases in which there is laryngeal ulceration. In other cases sodium-chloride solution and recent chlorine water are mixed in a suitable inhaler, such as the Oliver nebulizer.

Iodine is used for antiseptic, sorbefacient, and specific effect, in *pulmonary* and *laryngeal tuberculosis, acute* and *chronic rhinitis, laryn-*

gitis, *bronchitis*, and *pneumonia*, and in *syphilitic diseases of the air-passages*. It may be diffused through the air of a room or about a patient's bed from open vessels containing metallic iodine slightly moistened and exposed to artificial or atmospheric heat or to a current of steam. For direct inhalation various mixtures are employed. Scudamore placed in 5 oz. of distilled water from 1 to 4 drachms of a solution containing 3 grains each of iodine and potassium iodide to the drachm of alcohol, adding tincture of conium to mitigate the irritating qualities of the vapour, and exposing the whole to heat in a suitable inhaler. A simple method much employed is to drop tincture of iodine upon a sponge or dossil of cotton inclosed in a glass tube with a bulbous enlargement (Pomeroy's or Evans's inhaler). The effects of iodine, with the addition of a decided sedative action due to the other component, may be obtained from *ethyl iodide*, which, being volatile at ordinary temperatures, may be inhaled directly from the containing phial, or dropped upon the sponge of Yeo's perforated zinc respirator. Ethyl iodide is specially applicable in cases of *hay asthma* and other forms of *spasmodic dyspnœa*, in *pulmonary* and *laryngeal tuberculosis*, in *syphilitic disease of the air-passages*, and in *acute lobar pneumonia*. The frequency of administration will depend upon the gravity of the case, the duration of an inhalation upon the immediate effect, as vertigo is produced if it be too prolonged. The average time is five minutes; the average frequency, six times a day.

Nitrogen monoxide, apart from its use as a general anæsthetic, may be inhaled, pure or mixed with air or oxygen, as a *sedative*, *somnifacient*, and *antipyretic* agent. It is best administered from a rubber bag with or without a face mask, provided with a valve permitting entrance of air, or with the intermediation of a wash bottle from a cylinder in which it is contained under pressure. In *whooping-cough*, *asthma*, and other *neurotic* and *spasmodic affections* it often gives great relief. In the terminal stages of *pulmonary tuberculosis* it assuages cough, promotes sleep, diminishes hectic fever, and prolongs life. It may be used in *neurasthenic* and other forms of *insomnia*. As a rule it is best to give 8 gallons daily, or as much less as will produce the desired effect in one or two sittings, before noon. If necessary, from 2 to 4 gallons more may be given from 4 to 6 P. M., but the time, quantity, and frequency must be regulated according to the effect produced in the individual case.

Ether is used as a *sedative* in quantities and for times much short of those necessary to produce unconsciousness. It should be diluted with air by the method of administration, being best inhaled from a small phial. In *asthma* and *hay asthma* it may be used singly or in combination with ethyl iodide (equal parts). It has been highly recommended as a curative agent in *croup* (*laryngeal diphtheria ?*). It is sometimes a useful agent in the control of convulsions due to strychnine or the toxins of disease, but is generally inferior in such emergencies to chloroform.

Chloroform is used like ether, and like ether should always be diluted with air, being best inhaled from a phial. Its principal use is in acute emergencies, such as *strychnine poisoning*, *tetanus*, *uræmia*, *puerperal eclampsia*, and *angina pectoris*. It is of service, however, in relieving the cough of *chronic pulmonary* and *laryngeal tuberculosis*, and in the abortive treatment of *acute coryza* and the *coryza of influenza*. It may be used with caution in the palliative treatment of *asthma*.

Amyl nitrite, an antispasmodic and vascular stimulant, may be inhaled from the phial, a few drops may be placed on cotton, sponge, or cloth and held to the nostril, or a pearl may be crushed in a handkerchief. The dose is from 2 to 10 drops, it being usually given for effect. Its principal indication is the spasm of *angina pectoris*, but it is also used in *strychnine poisoning*, *uræmic* and other *convulsions*, *hay asthma*, *cardiac failure*, etc.

Ammonia, as given off by ammonia water, smelling salts, etc., is used in emergencies as a *stimulant* to respiration and circulation.

Ammonium chloride, as generated by the mingling of the vapours from ammonia water and from hydrochloric acid (for which purpose there are many forms of apparatus), is a useful stimulant to the nasal and laryngo-bronchial mucous membrane. It may be employed in the treatment of *chronic nasal catarrh*, especially of the atrophic variety, and generally in *chronic catarrhal conditions of the respiratory tract*. The vapour should be well washed by passage through two wash bottles of not less than a pint capacity (and preferably a quart) and not less than two thirds filled, and terebene may be usefully placed in the second wash bottle.

Steam, or it would be better to say the *vapour of water*, should not be inhaled at a temperature exceeding 140° F. It is *sedative*, *antispasmodic*, and *relaxant*. It is therefore applicable to *acute inflammations of the air-passages* and contra-indicated in chronic affections. It is especially harmful in laryngeal and pulmonary tuberculosis, in which diseases, however, it is perversely much employed. In the *capillary bronchitis* of children, and in *laryngeal croup* and *diphtheria*, steam may be allowed to diffuse through the air of the apartment, and being thus inhaled it facilitates the expectoration by the patient of the obstructing secretions and prevents to some extent the formation of tenacious mucus and fibrinous casts. In diphtheria and croup, especially after tracheotomy and to a less extent after intubation, the direct inhalation of steam through the mouth or tracheal tube is of great service. In these affections the most useful method of producing steam is to throw large chunks of unslaked lime into a tub or wash kettle containing water, and, properly protecting the child's eyes, direct the vapour into its throat. A tent should be placed around the bed, and within this the process is to be carried out. The particles of lime carried up aid in detaching the false membrane. (It remains to be seen whether the antitoxic serum will render this treatment superfluous, or whether it will

still be needed in a certain proportion of cases.) In *acute laryngitis* compound tincture of benzoin, or this and paregoric, equal parts, may be inhaled from steaming water. Elaborate apparatus is unnecessary though often convenient. A wide-mouthed jar or pitcher to contain a pint of water, leaving 3 or 4 inches "air space" above, a cone of paper or towelling or an inverted funnel to direct the vapour into the mouth, is sufficient. In subacute cases, creosote, eucalyptol, menthol, terebene, or camphor may be usefully added to the steam. In some of the mixtures prescribed light magnesium carbonate in the proportion of 1 drachm to 3 ounces is added to carry up the remedy more certainly.

Camphor is used with the vapour of water to cut short an attack of *coryza*, or to relieve the distress in later stages.

Menthol is inhaled from the crystals contained in a glass or celluloid tube for *chronic nasal catarrh* and *tuberculosis*, or from steaming water for *subacute laryngitis*. It may be diffused through an apartment in the treatment of *whooping-cough*, *croup*, or *capillary bronchitis*.

Eucalyptol may be inhaled from steam, from the phial, from the Yeo respirator, or from a sponge suspended in the manner of a locket about the neck. It is useful in *acute* and *subacute inflammations of the larynx*, in *diphtheria*, *amygdalitis*, *whooping-cough*, *chronic bronchitis*, and *laryngeal* and *pulmonary tuberculosis*.

Terebene is used in much the same manner and cases as eucalyptol. It is less active as an *antiseptic*, and more stimulating to the secretory functions. An extremely useful combination for inhalation from the Yeo respirator *pulmonary tuberculosis* consists of creosote, terebene, eucalyptol, and chloroform, equal parts.

Balsamic fumes and *vapours* may be evolved in various ways, according to the physical and chemical relations of the preparation employed. Powders, gums, and resins may be mixed with nitre and charcoal to make a slow-burning powder or mass (pastille) and fired, or they may be thrown upon live coals or a red hot metal plate, the fumes being inhaled directly or permitted to diffuse through the air of the room. Leaves may be made into cigarettes or smoked in a pipe, sometimes mixed with tobacco and narcotics. A Persian *narghile* is preferable for this purpose, the mass in the bowl of the pipe being moistened and covered with a live coal. Tinctures and other fluids may be thrown upon steaming water; or boiling water may be poured upon the crude drug or some solid preparation. These fumes and vapours are usually antiseptic, stimulating, and sometimes antispasmodic; they are used in *whooping-cough*, *asthma*, *laryngeal*, *bronchial*, and *pulmonary catarrhs*, and *pulmonary tuberculosis*. Among those most commended are ammoniacum, asafœtida, benzoin, cinnamon, copaiba, coltsfoot, cubeb, frankincense, galbanum, Peruvian balsam, and styrax.

Tar vapours had much vogue at one time in the treatment of *chronic inflammations of the respiratory tract*, and especially in *tuberculosis of the lungs*. A few ounces of prepared tar, mixed with water until soft, may be placed in an iron pot, which is then filled with water and covered with a tin lid having a projecting elbow or spout to direct the vapour into the room, and the apparatus is placed upon the fire or over a gas or lamp flame.

Narcotics.—*Opium* fumes may be inhaled from a pipe, in the Chinese method, or the gum opium may be burned on glowing metal by the patient's bedside, or the required dose made into pill may be placed upon a porcelain capsule over a flame and covered with some suitable contrivance for directing the air impregnated with the narcotic vapour into the patient's mouth or nostrils, as in Snow's inhaler. Perhaps the best way to use opium is to throw the camphorated tincture upon steaming water. It is sedative in *whooping-cough*, *bronchitis*, *laryngitis*, and *asthma*, and has been recommended to quiet the heart and relieve *cardiac* and *thoracic pain*.

Stramonium and *belladonna*—usually used with *potassium nitrate*, *tea*, and *tobacco* in various proportions—enter into most of the so-called *asthma cures*. They are unquestionably of palliative service. Espic's cigarettes contain belladonna leaves, 30 centigrammes; hyoscyamus leaves, 15 centigrammes; stramonium leaves, 15 centigrammes; phellandrium aquaticum, 5 centigrammes; extract of opium, 13 milligrammes; cherry-laurel water, 9½ grammes.

Conium is usually employed to mitigate such vapours as iodine. The solid extract or juice may be thrown into boiling water in a suitable inhaler, a small quantity of some alkali being added. It sometimes relieves *cough*.

Diluted hydrocyanic acid has sometimes been used to check rebellious *cough*, a few drops being thrown on steaming water. Cherry-laurel water forms a useful menstruum for other drugs with which a sedative is to be combined.

Potassium nitrate, as stated, is combined with stramonium and belladonna in *asthma powders*, the leaves being usually saturated with an aqueous solution of the drug and dried. Or pieces of blotting paper may be soaked in a saturated solution of nitre and dried; when used they are set on fire in a convenient vessel and inhaled directly or by diffusion.

Pyridine has been employed in the relief of *asthma* and of *angina pectoris*, one or two drachms of the liquid being poured in a plate and the fumes inhaled by the patient bending over it, or diffusion has been permitted in a small closed cabinet.

Mercury.—Fumigations of calomel are employed to produce rapid mercurialization. They have been strongly recommended by Brooklyn physicians (Corbin) in the treatment of *laryngeal diphtheria*.

Nebulized Fluids, or Sprays.—It is unnecessary to describe the construction or principle of the various apparatus employed for breaking up fluids into sprays of greater or less fineness, a process termed *atomization* or *nebulization*. As a rule, the term "sprays" is applied to the coarser forms used for irrigation or direct topical medication of the upper air-

passages, "nebulæ" to the finer forms suitable for inhalation. Any agent of the materia medica, sufficiently fluid, or soluble in water, glycerin, oil, or alcohol, may be thus employed. Two principal methods of nebulization may be referred to: the hot and the cold. In the hot method steam is employed to create the aspirating current in the nebulizing tubes, and the medicinal agent is thus inhaled together with the heated vapour of water. This method is applicable in *acute inflammations*, especially of the *larynx, trachea*, and *bronchi*, and in *croup* and *diphtheria*. It is less applicable in chronic affections, except these be characterized by excessive dryness of the mucous membranes, and is especially harmful in tuberculosis, whether of the lungs or larynx. In cold nebulization the most convenient method is that employing the principle of Oliver's apparatus, a fine spray being broken into a veritable cloud by impact against the wall of the containing vessel. The addition of glycerin to the inhalant mixture prolongs the time during which the nebula remains suspended in the air. It is not probable that nebulæ ordinarily penetrate far beyond the bronchial tubes of the second order, though it is unquestionable that under favourable conditions they may be made to reach the alveoli. Inhaled together with compressed air they will go farther than under ordinary circumstances. Their topical effects are therefore exerted chiefly upon the fauces, larynx, trachea, and large bronchial tubes, but by absorption systemic effects may be obtained, as in other methods of administration. A few of the principal agents employed by nebulization are referred to below:

Water.—Cold water may be used to allay heat, supply moisture, and cleanse the parts from secretion. It is thus useful in *amygdalitis* and less commonly in *laryngitis*. Ice-water may be used in *hæmorrhagic laryngitis*, and sometimes restrains a slight *pulmonary hæmoptysis*. Warm water is probably the most beneficial agent in most of the warm inhalations. "It is emollient, detergent, expectorant, absorbent, stimulant or sedative, according to the temperature of the spray and the prolongation of the inhalation." It is usually best to add a little cologne, benzoin, or toilet vinegar to render the inhalation pleasanter. It may be employed in *acute inflammations* of any portion of the *upper air-passages* or *bronchi*.

Mineral waters have been much used; of these, sulphurous, alkaline, and iron waters find their indications as *antiseptics*, *detergents*, *expectorants*, or *astringents*.

Carbonic-acid water sometimes relieves *simple sore throat* and *hoarseness* and fatigue from misuse of the voice.

Ammonium chloride is a useful *expectorant* and *stimulant*. From a grain to a drachm may be used with an ounce of water.

Sodium carbonate and bicarbonate (1 to 20 grains to the ounce of water) are chiefly useful to allay burning and remove viscid secretion.

Chlorine water (5 to 20 minims to the ounce of water) or solution of chlorinated soda (5 to 60 minims to the ounce of water), and *potassium permanganate* (1 to 8 grains to the ounce of water), are disinfectants and deodorants of the first rank, especially in *ozæna*, *fetid bronchitis*, *pulmonary gangrene*, *pulmonary tuberculosis with large cavities*, *diphtheria*, and *anginose scarlatina*.

Iron salts and tinctures ($\frac{1}{5}$- to 10-per-cent. solutions) are recommended chiefly as *astringents* and *hæmostatics*.

Alum (1 to 30 grains to the ounce) is *astringent* and *styptic*.

Carbolic acid (1 to 5 grains to the ounce) is a most useful remedy by steam nebulization in *croup* and *diphtheria*.

Sulphurous-acid water (10 to 60 minims to the ounce) is useful in *croup* and *diphtheria*, in *scarlatinal angina*, and less so in *pulmonary* and *laryngeal tuberculosis*.

Lactic acid (5 to 60 drops to the ounce) has been recommended in *diphtheria* and in *laryngeal tuberculosis*.

Wine of ipecacuanha (pure or diluted) sometimes relieves *spasmodic cough* and the *cough of chronic bronchitis*.

Opium and its alkaloids, *cannabis*, *hyoscyamus*, *conium*, *bromides*, and other sedatives are useful at times to allay pain and relieve *cough*. The dose that would be given by the mouth may be dissolved in an ounce of water and used by warm or cold nebulization as circumstances indicate.

Oil of turpentine and similar agents (from 1 to 5 drops to the drachm of glycerin and ounce of water) may be employed for the same purposes as by other methods of inhalation. A combination of an essential oil, a balsamic, and a terebinthinate with cherry-laurel water as the menstruum, used in Oliver's nebulizer, has often been most beneficial as a palliative in *pulmonary tuberculosis*.

Powders.—The writer has had no experience with the medicinal administration of powders by inhalation as distinguished from insufflation (*q. v.*). Alum, tannin, silver nitrate, borax, iodoform, calomel, sulphur, camphor, myrrh, sodium chloride, calcium phosphate, salicylic acid, are illustrative of the agents that have been recommended for use in this manner. Those having irritant or toxic properties should be properly diluted and the dose carefully regulated.—Solomon Solis-Cohen.

INJECTIONS, HYPODERMIC. — See Hypodermic Medication.

INJECTIONS, INTRAVENOUS.—Venous infusion (see under Transfusion).

INJECTIONS, RECTAL.—See Enemata.

INJECTIONS, SUBCUTANEOUS.—See Hypodermic Medication.

INJECTIONS, URETHRAL.—One of the oldest and best known methods of treating pathological conditions of the urethral mucous membrane is by the injection of medicated fluids, thus bringing the agent used into direct contact with the diseased surface and avoiding the digestive complications so often accompanying internal medication.

Urethral injections may be arbitrarily divided into four classes, as follows:

(*a*) *Simple injections*, which are applicable only to the anterior urethra, a small quantity of fluid only being used.

(*b*) *Retrojections*, where a large amount of fluid is injected through a catheter, which is *not* passed beyond the compressor urethræ muscle, the return fluid being allowed to flow out alongside of the catheter during the operation.

(*c*) *Irrigations*, in which a catheter is passed just beyond the compressor urethræ muscle, the bladder filled with fluid, and, after the removal of the catheter, the patient allowed to urinate, thus washing the entire urethral canal.

(*d*) *Instillations*, or "etchings," when a small amount of fluid is applied by means of a special syringe directly to the deep urethra alone.

Simple Injections.—These are applicable to all forms of *urethral inflammation*, either acute or chronic, and have the additional advantage that they may be used by the patient without assistance. The proper instrument for administering these injections is an ordinary piston syringe made of hard rubber or glass, with a conical point, and having a capacity of about two drachms.

In giving these injections the syringe is first filled by immersing the point in the fluid and drawing up the piston, all air being carefully excluded by holding the syringe upside down and gently pressing up the piston until the fluid flows out at the point. The penis should be held in the left hand with the glans between the forefinger and the thumb, which support it from beneath, so that when they are brought together the meatus is compressed and the injected fluid retained in the urethra as long as desired after the removal of the syringe. The syringe should be held between the thumb and middle finger of the right hand, while the forefinger moves the piston. The conical point is inserted into the meatus and wedged sufficiently firmly to prevent the escape of fluid alongside the syringe, the piston being pressed steadily home until the urethra feels fully distended. The thumb and finger of the left hand then compress the meatus, retaining the fluid in the urethra. The patient should always urinate before injecting, to prevent the discharge being washed backward by the injection, as well as to have as clean a surface as possible for the medicated fluid to act upon. In some instances the external vesical sphincter (compressor urethræ muscle) is so weak that it fails to prevent the fluid from entering the bladder even before the urethra is fully distended, in which case the patient should be instructed to make pressure on the urethra in the perinæum by sitting on the arm of a chair or other hard substance while injecting.

Almost every known substance has been used as the medicating agent in urethral injections, in the vain attempt to find a panacea for *gonorrhœa*; the principal indications for all are, however, that they should be antiseptic, should contain no insoluble ingredients (which may block the mouths of the minute glands of the urethra, and in this way cause small follicular abscesses of the urethral mucous membrane), and should not be sufficiently strong to produce undue suffering to the patient. It may be said here, however, that the tendency to the production of urethral stricture by strong injections has been very greatly exaggerated.

In acute inflammations only very mild antiseptic injections should be used, but they should be used more frequently than is necessary in the chronic forms of urethritis.

Bichloride of mercury 1 to 30,000, potassium permanganate 1 to 4,000, dioxide of hydrogen 1 to 4, and a 2-per-cent. solution of ichthyol are among the most useful medicaments during acute inflammation, and should be injected from six to eight times a day, four or five syringefuls being used at each sitting.

Later on, when the acute symptoms have passed, stronger solutions may be used, and drugs possessing an astringent action will be found useful; potassium permanganate, from 1 to 2,000 to 1 to 1,000, or nitrate of silver of the same strength, or solutions containing the sulphates or acetates of lead and zinc, the latter of which may be combined with the vegetable astringents sometimes with advantage. The *injection Brou*, which has acquired a very wide reputation among the laity, will serve as a type of this class of injection. According to Bumstead, it is as follows:

℞ Zinci sulph.		gr. xv;
Plumbi acetat.		gr. xxx;
Ext. krameriæ fl.,		
Tinct. opii	āā	ʒ iij;
Aquam	ad	℥ vj.
M.		

As the urethral mucous membrane is apt to become habituated to the action of any one drug, it is well to occasionally change the injection used.

Abortive Injections.—In attempts to abort a gonorrhœa taken at the outset, exceedingly strong injections are sometimes used, such as nitrate of silver from 20 to 40 grains to the ounce, but these are usually if not always inefficacious, exceedingly painful, and not to be recommended.

Retrojections.—This form is far more efficacious than the simple injection, as it thoroughly cleanses the urethra and brings the solution used into more active contact with the mucous membrane, but has the disadvantage that the patient himself can rarely master its technics. The apparatus necessary for its performance consists of an ordinary woven catheter (15 F.) connected by four or five feet of rubber tubing to an irrigator or fountain syringe having a capacity of from one to two quarts. The patient having been caused to sit on the edge of a chair over a basin or pail, the catheter, lubricated with glycerin or other soluble substance, is passed into the urethra about five inches, and the irrigator elevated two or three feet until the solution it contains forces its way out at the meatus, alongside of the catheter, falling into the vessel below, the urethra being washed from behind forward by the entire contents of the irrigator.

The same solutions may be used in this

method as for simple injections, but should usually be somewhat weaker to obtain the same effect.

Irrigations.—When the posterior urethra becomes involved, as it does in a very large majority of urethral inflammations, some other means than the preceding must be resorted to, in order to overcome the resistance of the compressor muscle. Probably the best method for accomplishing this is that devised by Professor Ultzmann, of Vienna. This consists in the introduction of a short silver catheter with four longitudinal slits instead of the usual eye, just beyond the compressor urethræ muscle; a hard rubber syringe of three or four ounces capacity, filled with a medicated solution, is then attached by means of a piece of soft rubber tubing to the end of the catheter, and the fluid gently injected into the membranous urethra, whence, easily overcoming the resistance of the weak internal sphincter vesicæ, it flows into the bladder. This is repeated until the bladder is filled so that the patient expresses a desire to urinate (usually about nine ounces are used), when he is allowed to immediately empty the bladder through the urethra, the catheter having been removed. The patient should be placed in the recumbent posture during the injection and the solutions used warmed, as cold fluids are apt to cause tenesmus. The same solutions may be used as in the retrojections. A favourite method of Ultzmann's was to begin with a solution consisting of sulphate of zinc, alum, and carbolic acid, each 1 part to 2,000 parts of water; on the next day the strength of this was increased to 1 to 1,500, on the third day to 1 to 1,000, and on the fourth to 1 to 500. If this was well borne the solution was changed to permanganate of potassium 1 to 2,000, which was increased in strength in the same way up to 1 to 1,000, when a solution of 1 to 2,000, of nitrate of silver was substituted, and in its turn gradually increased up to 1 to 1,000. In this way the urethra gradually becomes accustomed to the stronger solutions with but little inconvenience to the patient.

In cases where it is undesirable to pass a catheter, the bladder may be filled by hydraulic pressure alone, an ordinary irrigator with several feet of rubber tubing and a conical glass nozzle being used. The patient, after urinating, lies down, the nozzle is pressed firmly into the meatus, and the irrigator is elevated two to three feet, when the constant pressure soon overcomes the muscular resistance and enables the fluid to enter the bladder.

Instillations.—It is often desirable to apply a small quantity of a strong solution directly to the posterior urethra without allowing the anterior urethra to become involved. To accomplish this an instrument known as the "drop" syringe has been devised, which consists of a short silver catheter (15 F.) with very thick walls having only a capillary lumen. To its proximal end a hypodermic syringe is attached, its distal end having rather an abrupt curve and a well-rounded tip. The desired amount of the solution to be used is drawn up into the syringe, and the catheter introduced until the end has passed the membranous portion, which it is indicated when the long axis of the catheter is 45° from the vertical, showing that the triangular ligament has been passed. As many drops of the solution as desired may now be directly injected into the prostatic urethra. If the application has been properly made, none of the injected fluid will return, and a desire to urinate will soon be felt. Very strong solutions may be applied in this way without injury to the urethra, that of nitrate of silver, the drug most commonly used, ranging from 1 up to as high as 10 per cent.—William K. Otis.

INSUFFLATION, literally, *blowing in*, is a term applied to medication by means of a current of gas or vapour directed upon a surface or into a cavity, and usually carrying another substance, solid or gaseous, which is the active agent. (When liquids are thus applied, we usually speak of *spraying*.) Most commonly the propulsive current is of air, and the medicinal agent is in the form of powder; but air may likewise be employed for the propulsion of a medicinal vapour; and sometimes the insufflating gas or vapour is itself a medicinal agent. As a rule, insufflations are employed chiefly for local effect, though they may have an additional systemic effect. Sometimes they are employed for systemic effect chiefly, the local effect being merely incidental. Insufflations are administered by means of *insufflators*, varying in form in accordance with the physical characteristics of the medicinal agent and the anatomic conformation of the parts for which they are designed. The essential parts of a complete insufflator are a means of compressing the air or other gas used for propulsion, and a means for directing the current into or upon the proper part. When the propulsive current is not the medicinal agent, a receptacle for the latter must likewise be provided.

Air may be insufflated for pressure or temperature effects or to convey or remove moisture or medicine. Dentists frequently direct a current of heated air into tooth cavities in order to dry them preparatory to filling. The chief use made of insufflation of air in medical practice, apart from artificial respiration, is in dilatation of the Eustachian tube, and distention of the tympanum. This is usually effected by means of the Politzer bag, with or without the intervention of the Eustachian catheter. Insufflation of air into the peritoneal cavity, after the removal by aspiration of any fluid present, has been said to be curative in the treatment of *tuberculous peritonitis*. It is possible that the addition of chlorine or other antiseptic gas or vapour in non-poisonous quantity would increase the probabilities of success in this plan of treatment. For purposes of diagnosis, the stomach or the colon is sometimes distended by means of air or carbon dioxide gas, introduced through a soft rubber stomach tube. Cold air is sometimes blown upon accessible parts, such, for instance, as the structures of the mouth and throat, to allay pain or reduce inflammation, but as a rule other

means of employing cold in these situations are preferable.

Gases other than Air.—Any gas may be employed by insufflation, either for its own effect or as a carrier of other medicinal agents. Reference will be made only to those in ordinary use. *Carbon dioxide* has been employed chiefly as a carrier of hydrogen sulphide, eucalyptol, or iodoform vapour into the intestine, and thence by absorption through the venous channel into the lung, according to the method devised by Bergeon, of Lyons, for the treatment of *pulmonary tuberculosis*. Recently prepared, thoroughly washed, carbon-dioxide gas, collected in a rubber balloon, is passed by means of a handbellows through a flask of warmed natural or artificial sulphur water, or suitable reservoir containing eucalyptol or iodoform, and, as it takes up the hydrogen sulphide or medicinal vapour on its way, the two are slowly introduced into the rectum. From 2 to 6 litres of carbon dioxide are used, and a sulphur water of about the strength of that of Eaux bonnes. The Mt. Clement is the best American water. Artificial sulphur water for this purpose may be prepared at each operation by adding to 8 oz. of water 3 fl. oz. each of the following solutions: No. 1. Sodium sulphide, c. p., $\frac{1}{4}$ oz.; distilled water, 6 oz. No. 2. Tartaric acid, 1 oz. and 2 drachms; salicylic acid, $\frac{1}{2}$ drachm; distilled water, 6 oz. Some observers assert that the carbon dioxide is the therapeutic agent; it undoubtedly assists. The writer must again record his belief in the utility of this method as an adjuvant to others in the treatment of cases of pulmonary tuberculosis, with hectic fever, and moist cavities or active softening.

Hydrogen gas is used in abdominal surgery, according to the method devised by Senn, of Chicago, to detect perforations of the intestine. The gas is introduced per rectum, and by taking fire at the point of exit indicates the presence and site of perforation. Some surgeons condemn the method. It is possible that carbon dioxide and hydrogen sulphide, used by Bergeon's method and detected by reaction with lead-paper (blotting paper saturated with solution of plumbic acetate), would answer equally well. Undiluted hydrogen sulphide is poisonous.

Vapours.—*Chloroform*, usually mixed with heated air, is employed in Politzerization (distention of the Eustachian tube and tympanum). It may also be used for the relief of earache by insufflations into the external auditory canal. A convenient device for this purpose consists of a glass tube, having one end dilated into a convenient mouthpiece, the other drawn toward a point for insertion into the canal, and a bulb blown in the continuity into which a piece of sponge or wad of cotton may be inserted to receive the liquid chloroform. The bulb is quickly heated and insufflation made by means of the operator's breath. In a similar manner, but with a more delicate instrument, having a metallic tube, and the propulsive air being usually obtained from a rubber bulb, chloroform may be blown into the cavity of a tooth for the relief of pain or the absorption of moisture. *Bromoform* vapour may be blown into a tooth as an *antiseptic* agent as well as an *analgetic*.

Iodine may be blown into the Eustachian tube and middle ear by means of the Politzer bag and catheter. It is usually well diluted with air.

Menthol, *terebene*, *eucalyptol*, and similar agents are employed for the same purpose. Eucalyptol has likewise been employed for medication of the lungs by way of the rectum and venous channel according to the method of Bergeon, as described above. The chief use of *chlorine* in insufflation has been in the Bergeon process.

Powders.—Any solid medicinal agent in fine division may be employed by insufflation, and may be propelled by any gas or vapour. As a rule, air or the breath of the operator is used. Various forms of powder-blowers have been devised. The simplest is a tube, straight or curved, according to the part to which it is to be applied. The drug is inserted at either end, the operator applies his mouth to one end, and the powder is ejected at the other. Except in an emergency, when a quill or anything else may be used in this way, the method is obviously objectionable. The simplest modification of it is the attachment of a soft rubber tube and mouthpiece; next, the making, at a certain point in the tube, of a receptacle for the powder. The next step in advance is the substitution for the operator's breath of a current or puff of air derived from a rubber bulb conveniently attached or, by means of a connecting tube, from a reservoir of compressed air. A convenient form of insufflator consists of a receptacle (usually a glass tube or bottle) into which two tubes are inserted—one to receive compressed air, which stirs up the powder and forces it out through the other (delivery) tube. A valve of any simple form may be attached to the air-tube. Many different devices are to be found figured in the instrument-makers' catalogues.

Insufflation of medicinal powders is frequently employed in the treatment of *deep wounds*, *sinuses*, *cold abscesses*, *affections of the mouth*, *nose*, *throat*, and *ear*, and less commonly in *diseases of the rectum*, *urethra*, *bladder*, *vagina*, and *uterus*. When to use powders by insufflation, and when to resort to other means of topical medication, is a matter for skilful judgment in the individual case. As a rule, powders are applicable when instrumental applications would be painful or difficult, or when prolonged contact of the remedy with the parts is desirable. Some of the agents used are insoluble, and others act best in powder form. Agents employed by insufflation may be divided into diluents, adherents, protectants, absorbents, exsiccants, astringents, hæmostatics, antiseptics, alterants, anodynes, sedatives, stimulants, and solvents. As diluents, inert substances or those belonging to the class of adherents, protectants, exsiccants, or local sedatives are used. Many of the astringent drugs, as well as the powerful anodynes, need to be well diluted. Protectants should be moderately hygroscopic; *starch*, *milk sugar*, *boric acid*, *talc*, *lycopodium*, *sodium bicarbo-*

nate, and *acacia*, which last is the typical adherent, are useful. *Bismuth salts* (subcarbonate, subgallate, and subnitrate) are sedative as well as protectant, but will both diffuse and adhere better when mixed with powdered acacia. The principal absorbents and exsiccants are *charcoal*, *boric acid*, *talc*, *lycopodium*, *iodoform*, *prepared chalk*, and the *astringents*. As alterants, *sulphur*, *mercurials*, *iodine compounds*, and *caustic astringents*, such as silver nitrate or silver hyposulphite, well diluted, are employed. Astringents include *cinchona*, *kino*, and other drugs containing tannin, *tannic* and *gallic acids*, *hydrastis*, *sanguinaria*, *alum compounds*, and salts of *zinc* and *lead*.

The antiseptics most often used are *acetanilide*, *benzoic acid*, *bismuth subgallate*, *boric acid*, *calomel*, *dithymol diiodide* (called *aristol*), *iododiiso-butylorthocresol* (called *europhene*), *iodoform*, *sulphur*, *quinine*, and *resorcin*.

As hæmostatics, *alum preparations* and, the *vegetable astringents*, *acetanilide*, and *phenazone* have been employed. Anodynes and sedatives include those having a purely local effect and those having a systemic action also. Of any of the latter class, the quantity employed should be definite and safe. *Acacia*, *bismuth salts*, *sodium bicarbonate*, *belladonna*, *morphine*, and *cocaine* are the sedatives most commonly used.

As solvents of *diphtheric membrane*, *calomel* and *digestives*, such as *papain*, *pepsin*, and *trypsin*, have been used. It is said that *protonuclein* is active.

Stimulants are usually *sternutatories*, of which *pepper*, *sodium chloride*, and *tobacco* are the most common.

Benzoin, *benzoic acid*, and *balsams* are sometimes employed, usually in combination, to excite secretion from mucous membranes. *Galanga*, *sanguinaria*, *cubeb*, *camphor*, and, less frequently, *ipecacuanha*, are among the ingredients of so-called catarrh snuffs.

The following list of diseases and remedies in and with which insufflation is appicable is illustrative only, not exhaustive.

Abscess, cold.—Iodoform and its substitutes.

Aspergillus.—Boric acid, salicylic acid.

Catarrh, chronic nasal.—Benzoic acid, benzoin, bismuth salts, boric acid, calendula, cubeb, cerium oxalate, menthol, europhene, lycopodium, zinc stearate.

Croup and Diphtheria.—Boric acid, calomel, papain, pepsin, protonuclein, sulphur, trypsin.

Gonorrhœa.—Acetanilide, boric acid, iodoform, zinc stearate.

Hay fever.—Belladonna, boric acid, quinine.

Otitis media.—Boric acid, bismuth subiodide, calomel, iodoform.

Ozæna.—Benzoic acid, camphor, iodoform, zinc stearate, Peruvian balsam.

Pharyngitis and amygdalitis.—Benzoic acid, boric acid, resorcin, sodium bicarbonate, sodium salicylate.

Pertussis.—Benzoin, boric acid, coffee, quinine, silver nitrate with talcum.

Tuberculosis of joints.—Iodoform.

Tuberculosis of the throat. — Europhene, iodoform, protonuclein, resorcin, and anodynes. (Bismuth subcarbonate, cocaine, morphine, iodoform, and tannin in combination.)

SOLOMON SOLIS-COHEN.

INULA (U. S. Ph.), elecampane, is the root of *Inula Helenium*, a plant of the *Compositæ*. It was formerly much used as a *tonic* and in the treatment of *amenorrhœa*. It contains a camphor-like principle, *helenin*, which, although almost insoluble in water, is readily soluble in ether and in oils. Helenin has been recommended as an *antiseptic* and has been supposed to have a specific curative action in *tuberculosis*. Helenin has been thought also to have an elective action on the uterine glands, and hence to be useful in *leucorrhœa*, whether glairy or purulent and whether due to *endometritis* or to *anæmia*. For its action on the uterus it is given in the form of Hamonic's pills, each of which contains:

Crystallized helenin..... 0·31 grain;
Crystallized quassin...... 0·077 "
Iron protoxalate........ 1·54 "
Extract of cinchona, a sufficiency.

Two or three such pills are to be taken daily, after meals (*Gaz. de gynécol.*, Nov. 15, 1895). The dose of elecampane is from 10 to 20 grains; that of helenin is from $\frac{1}{6}$ to $\frac{1}{3}$ of a grain, three times a day.

INUNCTION.—The "rubbing in" of medicated fatty substances is practically confined to the use of mercurial ointment in the treatment of syphilis (see under MERCURY). That of simple fats is treated of on page 420.

IODAMYLUM.—Iodized starch (see under IODINE).

IODANTIPYRINE, or *iodopyrine*, is an iodine substitution compound of antipyrine. It appears to have the *antipyretic* and *analgetic* properties of antipyrine and possibly in addition some virtue as an *internal antiseptic*. It may be given in daily amounts of from 5 to 20 grains, in divided doses.

IODINE, *iodum* (U. S. Ph., Br. Ph.), *jodum* (Ger. Ph.), is "a non-metallic element obtained from the ashes of seaweeds and from mineral iodides and iodates" (Br. Ph.). Its symbol is I. It occurs in friable plates of a bluish-black colour and metallic lustre. Its odour is characteristic and its taste sharp and acrid. It is soluble in about 5,000 parts of water and in 10 parts of alcohol at 59° F., producing a solution which is brown in colour. It is more soluble in water to which certain salts, such as sodium chloride and potassium iodide, have been added. It is freely soluble in ether and soluble in glycerin. Iodine is slowly volatile at ordinary temperatures. Heated to 237·2° F. it melts and is volatilized as a purple vapour, and the inhalation of this vapour is productive of much irritation of the respiratory passages. In the presence of starch iodine produces a marked blue colour, and therefore starch is used as a test for the presence of iodine in solution. So delicate is this test that it is said to be possible to detect iodine in 450,000 times its weight of water. For the success of the test, however, it is necessary that the solution

be cold (the application of heat being followed by a disappearance of the colour, which, however, will return on cooling unless the heating is long continued) and the iodine free, and, since iodine in the body fluids is always in combination, a little nitric acid as well as starch is added to the solution, when, if iodine is present, it is liberated, and a blue colour is developed whose intensity varies with the amount of iodine. Iodine is obtained chiefly from South America, and from Chile in particular, for sodium iodate is found there in association with sodium nitrate. It is to some extent still obtained from seaweed, this, when burned, being known as kelp and used for the sake of its salts, among which is sodium iodide. The preparation of iodine from kelp is carried on to a considerable extent in Great Britain.

Applied to the skin, iodine is mildly caustic, a dry slough resulting from its prolonged contact. Applied in a diluted form it is counter-irritant, the result being a yellow staining of the skin and, if a sufficient amount has been applied, a sensation of heat and smarting with reddening of the skin and subsequent desquamation. Repeated application will result in the production of blisters, and in some skins this may result from a single application. The same results follow its application to mucous membranes, but the irritant action upon them is still greater.

When taken internally in small amount, iodine causes uneasiness and a sense of warmth and even of burning in the stomach, together with a metallic taste in the mouth. Larger doses cause intense pain in the stomach, vomiting, cramps, and purging. Iodine is an active poison, and its toxic effects are divisible into the acute and the chronic. Acute poisoning by iodine ordinarily results from swallowing a dose of considerable size. Under these circumstances there result severe œsophageal and gastric pain, vomiting, the vomitus usually being yellow unless starch is present in the stomach, when it is blue, purging, pallor with a cold, clammy skin and a small, thready pulse, prostration, suppression of urine in some cases, and finally collapse. Maniacal excitement and convulsions are sometimes observed. Although very large doses of iodine have been taken without ill effect, yet 20 grains are said to have caused death; on the other hand, recovery has followed the taking of 2½ drachms. For cases of acute poisoning the antidote is starch, but, as iodide of starch is not entirely inactive, the stomach must be thoroughly emptied as well. Acute poisoning may also result from the local use of iodine, generally from its injection into cavities of the body or into morbid growths, but occasionally from its too generous application to the skin. Under these circumstances the symptoms are in some respects similar to those which follow the taking of a poisonous dose by the mouth, but they are not the same. The symptoms which have been observed are thirst, salivation, difficult urination, diminution or suppression of urine, albuminuria, cyanosis, weak and rapid heart action, fever, vomiting, the vomitus containing iodine, cutaneous eruptions, generally hæmorrhagic in character, bleeding from various mucous surfaces, diarrhœa, priapism, a cold, clammy skin, prostration, and even collapse. Reaction may come on, but, even so, a fatal result may follow, sudden death having occurred in the midst of apparent convalescence.

The prolonged employment of iodine even in therapeutic doses may result in poisoning of a less acute variety. This is termed *iodism*, and among the disturbances thus produced may be thirst, epigastric pain, nausea, vomiting, diarrhœa, restlessness, sleeplessness, palpitation, and circulatory weakening, with progressive emaciation if the use of the remedy is continued. Iodism may follow the use not only of iodine itself, but of any of its salts. In the commonest form of iodism we find gastric disturbance and pain in the region of the frontal sinuses, often with coryza and perhaps with swelling of the eyelids. Papular and other eruptions are common, and in some cases salivation is observed or inflammation of the mouth and throat, perhaps with hoarseness, dysphagia, malaise, and fever. From the prolonged employment of iodine there is also said to have occurred atrophy of the testicles, as well as of the mammary glands. In iodism no treatment is ordinarily required beyond discontinuing the administration of iodine, and even if it is continued the symptoms may disappear from the establishment of tolerance. Iodism is less likely to occur if the iodine is given largely diluted, and arsenic is thought to lessen its ills.

When given by the mouth, and evidently also in some cases when injected into the tissues, iodine is absorbed and circulates, perhaps as sodium iodide. At any rate, it reaches and permeates all the tissues and fluids. The question as to how its therapeutic activity is elicited is as yet disputed, some thinking that iodine acts constitutionally only as an alkaline iodide, while others maintain that the action of the element and its salts is dependent upon the liberation of iodine in the tissues. Yet some do not agree to the similarity of action between iodine and its salts, thinking their actions essentially different. Iodine is eliminated mainly in the urine, but to a less degree by all mucous surfaces and perhaps by the skin. Upon the kidneys it is certainly active, irritation following its use in considerable doses, as is proved by the occurrence of albuminuria. Diminution and even suppression of urine are observed in persons violently poisoned, and it is said that a true nephritis may result from its employment. The constitutional effect of iodine is vague; though we ascribe to it alterative virtues, we are thereby not much nearer an understanding of its action, though some pronounced action over nutrition and its disorders it certainly does possess.

In *scrofulous diseases* iodine has certainly a decided action, and this we describe as alterative, which name, as I have already said, may vaguely describe, but certainly does not explain. In *chronic glandular enlargements*, in *scrofulous bone diseases*, and in *articular involvements* of a similar nature and chronic

character. it is often highly beneficial, though in such cases it is not so often used in substance as it is in the form of one of its salts, of which the iodide of iron is particularly to be recommended, especially when used in combination with cod-liver oil. Other scrofulous disorders are treated in the same way, among them *ozœna*, *lupus*, *caries*, *ulcers*, and *fistulæ*. In conditions of visceral induration the effects of iodine are often good. *Goître* in particular is benefited by it, provided it is simply a thyreoid hypertrophy we mean and not a degeneration, and so to some degree are *enlargements of the liver, testes, uterus,* and *mammæ*. In *chronic skin diseases* and in *chronic rheumatism* iodine seems to exert a favourable influence, though here, again, it is oftener a salt that is employed than iodine itself, and especially the potassium or sodium iodide. These salts, too, are beneficial in *chronic lead poisoning*, *tertiary syphilis*, and *chronic gout*, though the active agent in effecting the improvement is by many thought to be the iodine alone.

Chronic phthisis has been treated with iodine, it is said with success, but the practice is not common and the evidence as to its value does not appear convincing.

The vapour of iodine has been used for inhalation in the treatment of pulmonary disorders, especially *chronic bronchitis* and *pulmonary tuberculosis*, but, in spite of allegations as to its brilliant success when so used, this employment of iodine has not persisted, and indeed it can not be said to be altogether devoid of danger.

Enemata of iodine have been employed in *chronic diarrhœa* and *dysentery*, in which it is beneficial partly, it is said, because of a local action upon ulcerations when they are present and partly by absorption and alterative action. In using these enemata the rectum is first washed with a cleansing injection, and then there is gently forced in a sufficient quantity of warm water which contains from 1 to 10 fl. drachms of Lugol's solution in one or two quarts. This is done once or twice a day, the solution being gradually increased in strength. If the enema causes pain laudanum may be injected.

Parenchymatous injections of iodine given by means of the hypodermic syringe are often exceedingly valuable. A solution of iodine and iodide of potassium in water may be employed for this purpose, the strength varying with the necessities of the case, but tincture of iodine in variable amounts is oftener employed. Thus may be treated *chronically enlarged tonsils*, *lymphatic gland hypertrophies*, and *goître*, a few minims of the tincture being a sufficient amount for the injection. *Ovarian cysts* are treated in a similar way, tincture of iodine to the amount of a pint being injected into them after the removal of their fluid. This treatment is, however, applicable only to unilocular cysts, and certainly can not be regarded as anything but hazardous. In the same way *abscesses* may be evacuated and then filled with tincture of iodine to promote healing and diminish infection, but this treatment is rarely employed. *Hydatid cyst* may be cured by the injection of a few drops of the tincture of iodine. *Hydrocele* and *spina bifida* are treated in the same way, the end sought being the irritation of the wall of the cavity by the iodine and inflammatory obliteration. The injection of iodine has even been made into an *hypertrophied prostate*, by puncture through the rectum, the effect being to cause its diminution. This is certainly a dangerous procedure. In *empyema* of long standing the cavity may with benefit be washed out with a solution consisting of 5 grains each of iodine and potassium iodide in a pint of water. The washing may be done each day and the solution may cautiously be increased in strength. Other cavities, either natural (though diseased) or pathological, have been treated by iodine injections, among them those of *hernia*, *hydrocephalus*, *cystic bronchocele*, *dropsy of the joints*, and even *ascites*.

The most important use of iodine is its external application. As a mild counterirritant it is more serviceable than any remedy we possess, both because of its effectiveness and because of its convenience of application. The tincture is most frequently employed for this purpose, being painted on until the skin is deeply stained, and reapplied as the staining fades, until desquamation occurs. A vast number of conditions are so treated; in fact, so many that to name them is scarcely possible. A few, however, must be mentioned. Thus, iodine applied to the chest will relieve the *pain of pleurisy*, it will promote the absorption of *pleuritic effusion* and the resolution of *pneumonia*. Painted upon the neck, it is useful in *inflammations of the pharynx* and *larynx*. It will diminish the pains of *muscular rheumatism* when locally applied, and by its use are benefited *enlarged glands*, *chronic rheumatic affections*, *orchitis* in its later stages, *erysipelas*, *chilblain*, *goître*, and *superficial inflammation* in its early stages. To cause the diminution of *visceral enlargements*, iodine is applied at times in the form of the tincture, but more commonly in ointment. Thus may be treated *chronic indurations of the breast*, as well as *chronic hepatic*, *splenic*, *thyreoid*, *lymphatic*, and *articular enlargements*. Iodine is mildly antiparasitic, and therefore its local application as such, usually in the form of the tincture, is reasonable; rather more reasonable, however, than effectual. Nevertheless, *ringworm*, *pityriasis versicolor*, and similar conditions are often treated by the painting on of tincture of iodine. In skin diseases not parasitic in nature iodine may be locally applied as a stimulant and in some cases with success. Thus are treated *psoriasis* and *chloasma*. The pitting of *small-pox* may be prevented by a similar application. As an alterative and stimulant iodine may be employed, in solutions which will vary in strength with the delicacy of the part treated, for local application in *ozœna*, *ophthalmia*, *atrophic rhinitis*, *chronic cystitis*, *urethritis*, and *leucorrhœa*. Small doses of iodine are at times efficient in combating *nausea* and *vomiting*. By some, iodine has been thought a valuable intestinal antiseptic in *typhoid fever*, and has been given particularly in combination with carbolic acid. Fi-

nally, a peculiar method by which the constitutional effects of iodine are secured by means of its local application is the iodine bath. This is given in a wooden bath-tub, the water containing iodine in the proportion of about 3 grains to a gallon, and of potassium iodide about twice that quantity. These proportions are proper for adults; for children the strength of the solution should be three times less. The effect of the baths is to cause slight cutaneous redness, a yellow tinge, which, however, is but temporary, and in some persons with delicate skins a moderate desquamation. As to the efficacy of the procedure, it is slight and the practice is little employed at the present time.

Several preparations of iodine are official. Liniment of iodine, *linimentum iodi* (Br. Ph.), contains 5 parts of iodine, 2 parts of potassium iodide, 1 part of glycerin, and 40 parts of rectified spirit. Solution of iodine, *liquor iodi* (Br. Ph.), compound solution of iodine, *liquor iodi compositus* (U. S. Ph.), Lugol's solution, contains 5 parts of iodine in 100 of distilled water, the solution being effected by the addition of potassium iodide. The amount of potassium iodide in the United States preparation is 10 per cent.; in the British, 7½ per cent. The dose of this preparation is 5 minims. It is given largely diluted. Tincture of iodine, *tinctura iodi* (U. S. Ph., Br. Ph.), *tinctura jodi* (Ger. Ph.), according to the U. S. Ph. is a 7-per-cent. solution of iodine in alcohol; according to the Br. Ph., an alcoholic solution of iodine and potassium iodide, of each 2½ per cent.; according to the Ger. Ph., a 10-per-cent. alcoholic solution of iodine. The dose of the American preparation is from 5 to 15 drops; that of the British preparation, from 5 to 20 minims; that of the German tincture should not exceed 3 drops. Ointment of iodine, iodine ointment, *unguentum iodi* (U. S. Ph., Br. Ph.), consists, according to the American formula, of 4 parts of iodine, 1 part of potassium iodide, 2 parts of water, and 93 parts of benzoinated lard; the British ointment is composed of 7 parts of iodine, 7 of potassium iodide, 12 of glycerin, and 191 of prepared lard. Inhalation of iodine, *vapor iodi* (Br. Ph.), consists of 1 fl. drachm of tincture of iodine mixed with 1 oz. of water in a suitable apparatus and gently heated, the vapour which arises being inhaled. In addition to these there are a number of preparations of iodine which have not received official recognition. Such are "iodine paint," "iodized glycerin," *liquor iodi carbolatus* (Nat. Form.), *liquor iodi causticus* (Nat. Form.), and "iodized cotton." Of these the importance is comparatively slight and the employment infrequent.

Churchill's tincture of iodine, *tinctura iodi*, Churchill (Nat. Form.), deserves consideration, however, because it is in more frequent use. It is a preparation stronger than the official tincture and suitable only for external use. It contains 2½ tr. oz. of iodine, ½ tr. oz. of potassium iodide, 4 oz. of water, and enough alcohol to make 16 fl. oz.

For the internal administration of iodine Lugol's solution is by all means the best preparation. It should be largely diluted with sweetened water. Tincture of iodine may be given by the mouth, and indeed is so administered, but the practice is not rational, because of the probable precipitation of the iodine by the stomach juices. The tincture should, therefore, be reserved for external employment. The dose of iodine itself by the mouth has been placed by some between ½ and 1 grain, but the remedy should not be employed in substance, because of its irritant action. Three times in a day is the usual and sufficient frequency for administering iodine by the mouth, and it is to be taken preferably after eating, though if starchy matters are among the ingesta the action of the iodine is no doubt lessened to some degree by the formation of iodide of starch. The incompatibles of iodine are mineral acids, vegetable alkaloids, and metallic salts.

[Iodized starch, sometimes called iodide of starch, *amylum iodatum* (U. S. Ph., 1880), and *iodamylum*, was made, according to the U. S. Ph., 1880, with 95 parts of starch and 5 of iodine. It has been regarded as a definite chemical compound, but most chemists do not so consider it. In the form of iodized starch, iodine may be given internally in cases where irritability of the stomach would interfere with its administration in other forms. It may be given in doses of from a drachm to ½ oz. As a topical application it has been found useful in *lupus erythematosus* and in various forms of *scrofulous* and *tuberculous ulceration*. Majewski and Trzebicky have recently recommended it as an antiseptic dressing. Trzebicky (*Therap. Woch.*, Dec. 8, 1895), after considerable use of it as a dusting powder and incorporated with gauze, reports very favourably on its value as an antiseptic in *gangrenous*, *ill-conditioned ulcers* and as a packing for cavities left by the removal of tuberculous deposits.]

HENRY A. GRIFFIN.

IODOFORM, CHI_3 *iodoformum* (U. S. Ph., Br. Ph.), *jodoformium* (Ger. Ph.), is a substance of the same chemical composition as chloroform, except that iodine replaces chlorine. It occurs in small lemon-yellow hexagonal crystals, of a peculiar penetrating odour and an unpleasant, sweetish taste. It is not perceptibly soluble in water, but imparts to it a slight odour and taste. It is soluble at ordinary temperatures in about 52 parts of alcohol and in 5·2 parts of ether; very soluble in chloroform, in benzene, in fixed and volatile oils, etc. Iodoform is volatile at ordinary temperatures and at 230° F. it melts to a brown liquid, decomposing at higher degrees of heat. It should be kept cool and dark, in well-stoppered vessels.

Iodoform was discovered in 1822 by Sérullas, and was first used as a remedy in 1837 by Dr. R. M. Glover, of London, and M. Bouchardat, of Paris. It is used as powder, in solution, in gauze, lint, etc., in ointment, in pencils, in suppositories, in emulsions, etc. Iodoform has been given by the mouth, by inunction, and hypodermically.

It is said to be useful in *meningitis*, *cirrhosis of the liver*, *chronic dysentery*, *phthisis*, *diabetes*, *obesity*, *goître*, and many other diseases.

The dose is from 1 to 3 grains (0·06 to 0·18), by the mouth; it may be given in a pill or capsule. It is rapidly absorbed from the mucous membrane of the stomach and from fresh wounds, but is much more slowly taken up from granulating areas. In two hours after the administration of 5 grains, iodine may be found in the urine, saliva, and milk, and it may be three days before the entire quantity is eliminated. The smell of iodoform may be detected in the breath. In small doses the drug is a so-called *alterative*. In larger quantities it may become a narcotic poison, producing symptoms which will be described further on.

The most important uses of iodoform are local and depend upon its *anæsthetic* and *antiseptic* qualities. It is of great value as an application to the *inflamed mucous membrane of the genito-urinary organs, rectum, naso-pharynx, stomach*, etc. It is a soothing disinfectant for most *sloughing* or *ulcerating sores*, whether of *cancerous, tubercular, syphilitic*, or other *septic origin*, and is most valuable as a dressing for *recent wounds*. It is far ahead of any of the substitutes which have been proposed and tried, and since the early antiseptic days it has remained our main dependence. Yet iodoform is not a true antiseptic, for by itself it does not destroy micro-organisms. It is even washed by some surgeons before they use it. When it is in contact with wound secretions, however, it is decomposed, with the liberation of free iodine, a powerful germicide. The iodoform thus becomes the storehouse of the true antiseptic substance, which is furnished as fast as it is needed. So safe an antiseptic does iodoform thus become that even in operations involving the easily inflamed peritonæum it is used in gauze (iodoformized gauze, 5 to 10 per cent.) to pack away healthy intestine and to wall off normal peritonæum while septic matter is being evacuated. Even if some of this matter is absorbed by the iodoformed gauze, if the "walling off" process has been skilfully done, no infection of sound parts will occur. Immense intraperitoneal abscesses requiring instant evacuation have thus been opened and the gauze dams bathed in the pus, yet with no subsequent peritonitis. The gauze is left in place for some days, until firm adhesions have formed, and is then carefully removed.

In *painful septic diseases of the rectum, uterus*, or *vagina* this iodoformized gauze makes an excellent anæsthetic and antiseptic absorbent application, but when the absorbing qualities are not required suppositories made with cacao butter may be substituted. Gelatin pencils impregnated with the drug are also made for applying iodoform to the nostrils, to the urethra, to sinuses, etc. Though iodoform is usually a very non-irritating drug, the actual amount which may be absorbed should never be lost sight of; so it is well not to apply it thickly to very extensive surfaces.

Iodoform has been used hypodermically as an injection in solution or sterile emulsion—the latter with either glycerin or oil—for the cure of *goître, hydrocele*, and many *tuberculous affections*. In the cure of parenchymatous goître a 10-per-cent. solution is employed, and 2 or 3 drops are injected into the base of the growth. The needle is now partly withdrawn and inserted in another direction, where a similar amount is deposited. This procedure may be repeated until the iodoform has been deposited in many places. Good results are reported.

It is in *tuberculous disease*, however, especially in local tuberculosis, that this valuable drug is shown at its best. It seems that the tubercular products have a peculiar power to decompose the iodoform and to set free its antiseptic principle, and also that this antiseptic power is especially well marked in its action on the germs of tuberculosis. In tubercular ulcers, fistulæ, and sinuses leading into joints the iodoform may be injected with a glass piston-syringe, using a solution or emulsion. This should be done quite frequently, say, every two or three days. Flabby, gelatinoid granulations and tubercular pyogenic membrane become red and healthy-looking, the secretion diminishes, pain subsides, and the general health of the patient improves. Whether the cavity to be injected is large or small, it should be thoroughly filled, so that the remedy may reach every part. The superfluous liquid may then be allowed to escape, or this may be assisted by massage.

In the injection of iodoform emulsion—glycerin or oil—into closed cavities, such as joints or cold-abscess cavities, it is very necessary that the emulsion be carefully sterilized, preferably by heat, and that no quantity which may prove toxic be used. *Cold abscesses* should first be well aspirated with antiseptic precautions, and when the iodoform emulsion has been injected a gentle massage of the now flaccid abscess walls should be practised, so as to bring the substance into contact with as much diseased tissue as possible.

The same rules apply when we wish to inject the emulsion into a joint, but here even more than in the case of abscess should the strictest antiseptic precautions be observed. It is well to make a minute incision through the skin and to insert the needle through this incision, so that the danger of carrying foreign matter from the skin into the joint by means of the puncturing needle shall be eliminated.

In using iodoform powder as a dressing for *septic wounds*, great care should be taken not to use it in such quantities as to interfere with proper drainage. It is a common sight to see a crust composed of iodoform, dried pus, blood, etc., covering a filthy undermined septic wound. Iodoform is not contraindicated in such cases, but it should be combined with moist or oily dressing, which should be changed often.

One disadvantage which has been urged against iodoform is its peculiar penetrating and suggestive odour. While this can not be entirely covered, there are certain substances which modify it to a very marked degree and make it not easily recognisable. Of these the best are coumarin and vanillin, which may be well mixed with iodoform in the proportion of one to nine (10 per cent.). Tannin has been employed for this purpose, but as it acts by de-

composing the drug it is worthless, and should not be used.

Iodoform should never be prescribed with calomel, because of the formation of mercuric iodide, a very poisonous drug.

Iodoform Poisoning.—On account of the widespread use of iodoform and its popularly supposed harmlessness, it is of importance to know and recognise its untoward effects. These may be local or general or both. When both are present, the constitutional effects are often directly dependent on the local. Iodoform intoxication, of whatever form, is supposed to be usually due to idiosyncrasy.

The local poisoning begins as a crop of very small, thick-walled vesicles, not much raised above the surrounding skin, but so close together that the entire neighbourhood looks swollen. Wherever iodoform has been brought in contact with the skin we find these vesicles, and around the more acutely poisoned area discrete vesicles appear—perhaps wherever a minute speck of iodoform has fallen. The vesicles are at first filled with a clear serum, but this may rapidly become sanguinolent or turbid. When it is sanguinolent the entire part has a dark-blue, gangrene-like appearance. On account of the raising of the epidermis from the corium, sensation is diminished, thus increasing the resemblance to superficial gangrene. In a few days the vesicles which have become confluent burst, and expose larger or smaller areas of intensely red, highly sensitive corium, from which large quantities of serum exude. Around this area are smaller similar patches, and in the remoter periphery are younger isolated vesicles, which may be freshly poisoned spots, for it is quite common that, the condition being unrecognised, the inflamed surface is still further treated with iodoform. A case has indeed been studied where iodoform ointment was applied to a minute abrasion over the inner malleolus. The resulting dermatitis was treated with more iodoform ointment, so that ultimately the skin of the entire leg and foot was one excoriated, bleeding, itching, and burning surface. A crop of new vesicles reached far above the knee, for the whole diseased part was enveloped in a large piece of lint thickly spread with iodoform ointment. Where such large surfaces of dermatitis exist, there is much danger that by absorption of the drug constitutional symptoms of poisoning may occur.

The prognosis of local poisoning is good with proper treatment. This treatment consists, first, in removing every particle of iodoform from the surface by careful washing with a mild soap and warm water, or it may be more easily accomplished with cotton and ether. A soaking wet dressing of some bland solution, such as normal salt solution, should be applied for a few hours, and then all the tops of as many vesicles as possible should be trimmed off with scissors. The wet dressing may be reapplied for twelve hours, then some soothing ointment, such as benzoated lard, fine zinc-oxide ointment, or a similar preparation, on the smooth side of lint. The recovery is usually rapid. During convalescence vesicles are frequently observed in remote parts of the body, but by careful questioning and observation one usually finds that the affected fingers or perhaps the iodoformized dressings have in some way reached and touched these parts and have poisoned them.

The constitutional form of intoxication by this drug may be divided into two forms, the acute and the chronic. Acute poisoning may come on immediately after the absorption of a large quantity of iodoform, usually from a wounded surface. Men past middle life are most often affected. In twenty-four hours after the application of the drug there is a mild delirium, usually with unpleasant hallucinations of sight, a progressive inability to recognise persons and places, extreme forgetfulness, and gradually loss of consciousness. There is a smell of iodoform in the breath, there is a yellow discoloration of the skin and conjunctivæ, the pupils are contracted, the pulse is small and rapid, and often there are nausea and vomiting with anorexia. The symptoms are said to resemble those of meningitis. There is a marked and surprisingly rapid emaciation. Occasionally a measles-like, or even scarlatiniform, eruption occurs, first on the anterior surface of the body and limbs, later all over the body, face and scalp included. The prognosis is bad, even if the source of the trouble is removed, and death, preceded by coma, occurs usually in from five to eight days after the onset.

The chronic variety of intoxication presents quite a different picture. It usually, but not invariably, comes on after iodoform has been used, perhaps in small doses, for a long time—weeks, or even months. Here, also, old men are the most frequent victims. It may come on from the use of a daily suppository containing but one grain of iodoform, or from the small amount absorbed from the bladder where the chemical has been used to relieve a cystitis. The attack often begins at night, with melancholia, delusions of persecution and threatened bodily harm being common. Gradually there is bewilderment, with increasing excitement, until the patient exhausts himself and dies in coma. The prognosis in such cases is almost uniformly bad. The treatment is general, the patient's strength being kept up if possible until he is able to eliminate the poison. Codeine, hyoscyamine, etc., are of use in quieting the excitement. Such patients are often strongly suicidal, and must be carefully watched.

[Iodoform has been used with great success in the treatment of *suppurating inguinal buboes.* Fontan's method of employing it, as described by Rullier (*Arch. de méd. et de pharm. milit.*, 1895, No. 3; *Therap. Gaz.*, Apr., 1895), consists of, first, thorough antiseptic cleansing of the operative region, followed by puncture and complete evacuation of the pus. Vaseline mixed with 10 per cent. of iodoform, liquefied by heat, is then injected and a bichloride-of-mercury dressing applied. The complete evacuation of the pus is one of the essential conditions for success. Before the iodoform injection the whole cavity is washed out with

a 1-to-1,000 solution of bichloride of mercury. If this occasions bleeding, pressure with wet sublimated cottion is exerted, and the flow of blood ceases. The iodoform vaseline mixture is liquefied by putting the vessel in which it is contained in a water-bath heated to 116° F. The suppurating cavity should be filled, but not distended. The pain, says M. Rullier, disappears from the first day, the periadenitis rapidly lessens, and a cure is accomplished in six or seven days, leaving no cicatrix or other visible trace. In about 12 per cent. of the cases the puncture closes at once, and the patient is able to resume his duties in a day or two. In most instances there is some discharge of vaseline with a few drops of pus for a few days. The wound should then be washed antiseptically and dusted with iodoform. If the cavity is not obliterated, a fresh injection of vaseline should be made in two days, followed by a third two days later, if this is required. This treatment is said to fail only when the skin is so thoroughly devitalized that sloughing takes place. Very favourable results from its employment have been reported by Dr. William K. Otis (*Jour. of Cutan. and Genito-urin. Dis.*, May, 1893) and Dr. James R. Hayden (*Am. Jour. of the Med. Sci.*, Nov., 1895). Before injecting the iodoform ointment, Dr. Hayden irrigates the cavity with a strong solution of hydrogen dioxide, and then with a 1-to-5,000 solution of corrosive sublimate. He reports fifteen cases, all of which were cured in from seven to twenty-one days. The cases were not pronounced cured "until firm pressure in the groin elicited neither pain nor fluctuation, and the overlying skin had resumed its normal appearance."

The inhalation of iodoform vapour has been employed in the treatment of *coryza* and *bronchitis*. At the onset of coryza M. Maurel (*Rev. internat. de méd. et de chir. prat.*, Jan. 10, 1895) fixes a piece of cotton saturated with iodoform in the nasal fossa, and says it does not provoke either annoyance or irritation. The iodoform vapours are thus brought constantly in contact with the mucous membrane, and the coryza disappears rapidly without causing descending bronchitis. Together with this treatment M. Maurel uses iodoform pastilles, each containing 3 milligrammes (0·046 of a grain), and the fumes of six of these are inhaled by the patient every day. In this manner the respiratory tracts are influenced by the iodoform vapours.

The official iodoform ointment, *unguentum iodoformi* (U. S. Ph., Br. Ph.), consists of 1 part of iodoform and 9 parts of benzoated lard. Iodoform suppositories, *suppositoria iodoformi* (Br. Ph.), contain each 3 grains of iodoform].

Arpad G. Gerster.
Howard Lilienthal.

IODOFORMIN, $C_3H_6N_2I_2$, obtained by treating a solution of formin with an alcoholic solution of iodine, is an odourless crystalline substance, insoluble in all ordinary menstrua. It has been used externally as a substitute for iodoform, and is said to be quite as efficient.

IODOL, or *tetraiodopyrrhol*, the formula of which is variously given as C_4I_4NH and C_8HI_4N, is formed by the action of iodine upon pyrrhol. It is a grayish-white powder that turns to yellowish brown upon exposure to light, and is composed of long prismatic crystals. It is almost insoluble in water, but is quite soluble in alcohol, in ether, and in oils. It has no taste or odour, and it contains 88·9 per cent. of iodine, thus closely approaching iodoform, which contains 96·7 per cent. of iodine.

Experiments made on the lower animals show that iodol, given in sufficiently large doses for a long enough time, cause emaciation, general loss of muscular power, decrease of temperature, albuminuria, and eventually death due to fatty degeneration of the liver and kidneys. It is soluble in the gastric secretions, and is decomposed, the iodine being liberated.

Iodol is said to be much less likely to produce toxic symptoms than iodoform is, although it is capable of causing such sequelæ. Topical applications may cause pyrexia, cardiac excitement, vomiting, and albuminuria, and iodine will be found in the urine for some time.

Experimental and clinical investigation have shown that iodol is absorbed slowly; twelve hours after the ingestion of 7½ grains of iodol, iodine has been detected in the urine and saliva, the maximum quantity being attained in eighteen hours and iodine remaining present for seventy-two hours.

Iodol may be applied as an impalpable powder, or in solution or in an ointment, for all the purposes for which iodoform is used. Its freedom from odour makes it preferable in some conditions. As an application in the various forms of *balanitis*, in *soft chancre*, and in *suppurative bubo* the writer has found it inferior to iodoform in remedial properties. In *vaginal catarrh* it has proved serviceable: it may be applied with a brush or by insufflation. It may be applied in powder to *ulcers*, and to discharging *furuncles* and *carbuncles*, though an ethereal solution (1 drachm of iodol to 1 fl. oz. of ether) will penetrate the affected tissues more thoroughly. An ointment containing from 10 to 20 grains of iodol to the ounce is of service in *psoriasis*, *tinea tonsurans*, and *caseous glands*. Some clinicians have found insufflations of iodol useful in *granular pharyngitis*, *posterior rhinitis*, *chronic inflammation of the Eustachian tube*, *otitis media*, *tuberculous laryngitis*, and *chronic bronchial catarrh*. The powder may be applied in *catarrhal conjunctivitis* and *trachoma*.

Iodol may be administered internally in any condition in which iodine is indicated, and it is said that in therapeutic doses it will not cause iodism. In consideration of its slow excretion it should be given in small doses, from 1 to 4 grains two or three times a day, the urine being examined daily for albumin, as individual susceptibility to the drug differs.

Samuel T. Armstrong.

IODOPHENACETINE, IODOPHENINE, a compound of phenacetine and iodine, is a brownish crystalline powder having the odour of iodine, of which it is said to contain 51·5 per cent. It is insoluble in water, but soluble in glacial acetic acid and slightly solu-

ble in benzene and in chloroform. It has been used topically as a substitute for iodoform.

IODOPYRINE.—See Iodantipyrine.

IPECAC, IPECACUANHA (U. S. Ph., Br. Ph.), *radix ipecacuanhæ* (Ger. Ph.), is the dried root of *Cephaelis ipecacuanha*, a small plant native to Brazil. It is cultivated with some slight success in India. Ipecacuanha contains extractive, gum, resin, starch, lignin, volatile oil, sugar, a peculiar acid (or glucoside) which resembles quinic acid, and is called *ipecacuanhic acid*, also an alkaloid called *emetine*, which is believed to be the active principle of the drug. Pure emetine is a white, amorphous, pulverizable substance without odour, of somewhat bitter taste, little soluble in cold water, somewhat soluble in hot water, and freely soluble in alcohol. It forms salts which, as a rule, are uncrystallizable, but a crystalline hydrochloride is said to have been prepared.

Applied to mucous membranes, ipecac is decidedly irritating, the nose showing its intolerance to the remedy by violent sneezing. To excoriated surfaces it is also an irritant, and even to the skin, though in the latter case not on mere application, but on inunction. This rubbing of ipecac upon the skin occasions an eruption of small pustules, which subsequently become large if the application is continued, and even result in severe ulceration. Given by the mouth in doses of less than a grain, ipecac acts as a *stomachic*, increasing the gastric tone and augmenting gastric secretion. It is thus sedative to a relaxed mucosa and efficient thereby as an *antemetic*. The continued administration of small doses, especially if they are frequently repeated, may be productive of gastric discomfort, nausea, and increase of the salivary, bronchial, and gastric secretions. In doses of from 5 to 20 grains ipecac is *emetic*. This emesis is partly centric, for the hypodermic injection of emetine, too, causes vomiting, but the vomiting thus produced is slower in its appearance than when the drug is given by the mouth, and gastric action is therefore no doubt the more important factor in ipecac emesis. Ipecac for emetic effect is, therefore, invariably given by the mouth, but even when so administered it can not be held to be a rapidly acting remedy, from a quarter to half an hour usually elapsing before vomiting takes place. The vomiting from ipecac is not persistent, as a rule, and nausea, though present, is generally not severe. Depression to some degree follows the vomiting, but this, too, is apt to be comparatively slight. Occasionally catharsis will follow the use of an emetic dose, but this is oftener the result of moderate doses long continued, for the stomach in time may become tolerant of the remedy, and even considerable doses may be borne. The action of ipecac to cause evacuation of the bowels is principally due to its influence upon the liver in promoting the secretion of bile; this influence seems proved by the experiments of Rutherford, and the stools which ipecac produces are certainly "bilious" in a high degree. No doubt the intestinal secretions are increased as well; it could scarcely be otherwise, since emetine, though eliminated by other secretions also, is mainly excreted from the gastric and intestinal mucous membranes. I have already said that small and repeated doses of ipecacuanha will produce increase of bronchial secretion; this power it has in common with the others of the nauseant class, for nausea, as we know, is accompanied by increased secretion from the bronchi. The depressing expectorants, as a class, therefore, probably owe this action to their nauseant properties, and the expectoration they cause is undoubtedly but an early phenomenon of their action as nauseants and emetics. Ipecac is a depressing expectorant of great value. Akin to its action upon the bronchi, and explicable in the same manner, is its action upon the skin; ipecac relaxes the integument to a high degree, and much increases the production of sweat.

The physiological action of ipecacuanha has not as yet been demonstrated in every particular. Upon the circulation its action, save as circulatory phenomena may accompany the act of vomiting, is not a pronounced one, and therapeutic doses may, so far as the heart and blood-vessels are concerned, be considered inactive, though, experimentally given to animals, emetine in large amount has caused death from cardiac paralysis. The respiration reacts in the same way to ipecac, therapeutic doses having no effect, and poisonous doses, experimentally given, causing death in some cases from paralysis of respiration. Whether this paralysis is peripheral or centric is a disputed question. The nervous system is practically unaffected by the drug, though possibly there is a diminution of reflex activity of the spinal cord. The temperature of the surface in experimental cases is lowered by ipecac, while that of the interior of the body may remain stationary or rise. This rise may be due, as has been suggested, to the irritant action of the drug upon the alimentary mucous membranes. In animals poisoned by ipecac there are found intense gastric and intestinal congestion with, generally, congestion and even hepatization of the lungs, though in some cases a pulmonary anæmia is observed. In man, poisoning by ipecac is improbable, for the action of the remedy in an overdose is to cause its own expulsion, and hence to prevent the occurrence of serious consequences. Emetine, however, because of its violence as an irritant and a more prolonged effect, may be productive of serious results.

It is to cause vomiting that ipecac is most frequently employed in medicine, and certainly it is one of the most efficient remedies of the emetic class of which we are possessed. It is generally reliable, too, and advantageous because of the relative freedom of its action from accompanying nausea and subsequent depression. In all cases where the stomach is to be unloaded of food which is improper in quality or in amount, no better remedy can be had. In *poisoning*, also, it is efficient; if the poisoning is of the narcotic variety it will generally work well, though it must be confessed that a drug which acts upon the stomach only in causing vomiting is theoretically to be pre-

ferred, because narcotic poisons probably diminish the irritability of the vomiting centre as well as that of the other centres. In *acute gastritis* and in the familiar *bilious attack* an emetic dose of ipecac may help the stomach to empty itself and thus may bring pronounced relief. In *migraine* its action is similar. The use of emetics to abort or "break up" *acute febrite disease* has already been discussed (see EMETICS), and the practice criticised. It seems unreasonable to expect any value from such treatment unless the stomach contains matters whose removal is indicated, or unless perspiration is desirable, and in the latter case emesis is certainly not necessary, as witness the use of Dover's powder, or when a nervous element enters into the case which may be removed by the occurrence of vomiting. Certainly the use of emetics in infectious disease seems highly absurd, except in malarial disease, where, because of the usual disturbance of hepatic function, a large dose may be beneficial in a way similar to that of a mercurial purge, and as an introductory to the use of quinine or another antiperiodic. The removal of obstruction of the respiratory passages, such as occurs in *membranous croup*, in *bronchitis*, and with *foreign bodies*, is well done by ipecac, because of the expulsive action which vomiting necessitates, not only from the stomach but from the lungs. *Laryngismus stridulus*, too, is much relieved by an emetic dose of ipecac, because of the muscular relaxation it occasions. Theoretically, it is less relaxing and therefore less applicable than other emetics which nauseate more, but practically it is efficient and, above all, it is safe. The domestic employment of syrup of ipecac in spasmodic croup is therefore to be recommended, the usual directions being to give from ½ to 1 teaspoonful every twenty minutes until vomiting has occurred or until four or five doses have been taken, the remedy being assisted in its action perhaps by the free administration of warm water, with or without salt, and the insertion of the finger into the patient's throat. In *vomiting of nervous origin* this remedy may be an efficient antemetic, and the usefulness of wine of ipecac in the *vomiting of pregnancy* is well known. The dose in such a case is one drop, generally given in a small quantity of water, and repeated hourly. The *vomiting of gastric atony* may be relieved by the same procedure, as is seen in cases of *chronic atcohotism*. In *diarrhœal conditions* ipecac is often serviceable. The *diarrhœas of young children*, which so often occur in the summer months and in which the stools are greenish and contain mucus and blood, are often, by this means, wonderfully relieved, the bilious character being restored to the movements, and a healthful stimulation of the alimentary mucosæ no doubt occurring. Small doses are of course suitable in these cases; Bartholow places the range between 2 and 5 grains.

In *acute dysentery* the action of ipecac is often remarkable, the tormina and tenesmus disappearing, the character of the movements improving, and the constitutional symptoms being relieved. It is particularly in the dysentery of tropical and malarious districts that the benefits are seen, and to secure them the doses must be large in size, from 20 even to 60 grains being appropriate. The difficulty of retaining a dose so large is of course great, and often many a trial is necessary before success results, but if a hypodermic injection of a small dose of morphine is previously given, if a mustard plaster is applied to the epigastrium, and if absolute quiet is enjoined, the chances of success are good. Ipecac deprived of its emetine (*ipecacuanha de-emetinisata*) may be used in dysentery, and is said to be as efficient as the unaltered drug. It has also been said to be free from nauseating and emetic powers, but this is certainly a mistake, though those powers are less than in the unchanged drug. *Chronic dysentery*, too, may be benefited by ipecac, the method of administration being the same as in acute cases, though some prefer the prolonged use of smaller doses. In chronic cases, however, improvement is less likely, especially if they have existed for a long time and if extensive ulcerations are present. Ipecac is an excellent remedy in *hæmoptysis;* it is given in small and frequently repeated doses until nausea occurs. In other hæmorrhages, such as *menorrhagia* and *epistaxis*, it is useful also. In *post-partum hæmorrhage* it may be given in combination with ergot. In *catarrhal jaundice* the employment of ipecac is useful and should be continued for a considerable time. On account of its power over hepatic function it is useful in the various forms of *malariat disease*.

As a depressing expectorant ipecac, given in small doses, is unrivalled. With it may be treated *bronchial catarrh*, especially the acute form, *acute laryngitis* and *pharyngitis*, *hay-fever*, and various forms of *cough* which are not necessarily bronchial in origin. In *whooping-cough* an emetic dose of ipecac is often serviceable in clearing the bronchi of accumulated mucus. Ipecac is said to be destructive to the bacillus of anthrax, though not to its spores. The spores being absent from the body in *matignant pustute*, however, there is reason for the use of ipecac in this disease, and success has followed its use. The remedy may be given in moderate doses and repeated at intervals of four or five hours, and, the pustule having been excised, the wound may be dressed with ipecac as well. By some ipecac has been recommended as an *oxytocic*. The wine of ipecac has been much used as a spray for inhalation in *chronic bronchitis* and *emphysema*. This procedure is certainly efficient in a large number of cases, and the improvement is usually of long duration. Ipecac is occasionally used externally as a *counter-irritant*, and for this purpose it may be made an ingredient of liniments.

The dose of ipecac in powder will vary with the effect sought. As an emetic, 20 grains may be given suspended in water, and repeated every twenty minutes until it is effective. In some cases smaller doses are sufficient. As a nauseant, it may be given in 2-grain doses and repeated as often as necessary. As a diaphoretic, the dose is a grain, and for this purpose

ipecac is generally given combined with opium (see OPIUM). As a gastric and intestinal tonic the dose is from $\frac{1}{4}$ to $\frac{1}{2}$ a grain given three times a day. Emetine has been used as a substitute for ipecacuanha, but is not entirely free from danger, because of its violence of action. It will cause vomiting if applied to a denuded area. The dose of pure emetine is $\frac{1}{8}$ of a grain or less.

There are a number of preparations of ipecac. The fluid extract, *extractum ipecacuanhæ fluidum* (U. S. Ph.), may be used as an emetic in doses of from 15 to 30 minims. Powder of ipecac and opium, compound powder of ipecacuanha, Dover's powder, *pulvis ipecacuanhæ et opii* (U. S. Ph.), *pulvis ipecacuanhæ compositus* (Br. Ph.), *pulvis ipecacuanhæ opiatus* (Ger. Ph.). contains one part each of powdered ipecac and powdered opium in ten parts. The excipient of the U. S. Ph. and the Ger. Ph. is sugar of milk; that of the Br. Ph. is potassium sulphate. The dose of Dover's powder is from 5 to 15 grains. Troches of ipecac, ipecacuanha lozenges, *trochisci ipecacuanhæ* (U. S. Ph., Br. Ph.), according to the U. S. Ph., consists of ipecac, tragacanth, sugar, and syrup of orange. Each troche contains about $\frac{1}{3}$ of a grain of ipecac. The lozenges of the Br. Ph. consist of ipecac, refined sugar, gum acacia, and mucilage of gum acacia, each containing $\frac{1}{4}$ of a grain of ipecac. The dose is from 1 to 3 lozenges. Their use is in *respiratory catarrhs.* Troches of morphine and ipecac, morphine and ipecacuanha lozenges, *trochisci morphinæ et ipecacuanhæ* (U. S. Ph., Br. Ph.), according to the U. S. Ph., consist of morphine sulphate, ipecac, sugar, oil of gaultheria, and mucilage of tragacanth. Each contains $\frac{1}{40}$ of a grain of morphine sulphate and $\frac{1}{12}$ of a grain of ipecac. The lozenges of the Br. Ph. consist of morphine hydrochloride, ipecac, tincture of Tolu, refined sugar, gum acacia, and mucilage of gum acacia, each containing $\frac{1}{36}$ of a grain of morphine hydrochloride and $\frac{1}{12}$ of a grain of ipecac. From 1 to 6 troches, either of the U. S. Ph. or the Br. Ph., may be given at a dose. Their use is especially for diminishing *cough.*

Syrup of ipecac, *syrupus ipecacuanhæ* (U. S. Ph.), *sirupus ipecacuanhæ* (Ger. Ph.), contains, according to the U. S. Ph., 7 parts of fluid extract of ipecac, 1 part of acetic acid, 10 parts of glycerin, 70 parts of sugar, and enough water to make 100 parts. The emetic dose for an adult is from $\frac{1}{2}$ to 1 fl. oz.; for a child one or two years old, from $\frac{1}{2}$ to 1 fl. drachm, repeated every twenty minutes until it is effective. The expectorant dose for an adult is from $\frac{1}{2}$ to 1 fl. drachm; for a child, from 2 to 10 minims. An ounce of the syrup represents the virtue of 30 grains of ipecac. The preparation is much employed. Wine of ipecac, *vinum ipecacuanhæ* (U. S. Ph., Br. Ph., Ger. Ph.), contains, according to the U. S. Ph., 1 part of fluid extract of ipecac, 1 part of alcohol, and enough white wine to make 10 parts. An ounce represents the virtue of about 42 grains of ipecac. The emetic dose for an adult is 1 fl. oz.; the expectorant and diaphoretic dose, from 10 to 30 minims; the emetic dose for a child one or two years old is 1 fl. drachm, repeated every twenty minutes until it is effective. The British preparation is made with 1 oz. of powdered ipecac and 1 fl. oz. of acetic acid macerated together for a day, when distilled water is percolated through them until a pint of liquid results. This product is reduced to dryness, powdered, macerated in a pint of sherry for two days, and filtered. An ounce represents the value of about 20 grains of ipecac. According to the Br. Ph., the emetic dose is from 3 to 6 fl. drachms; the expectorant dose, from 5 to 40 minims. Tincture of ipecac and opium, *tinctura ipecacuanhæ et opii* (U. S. Ph.). contains 10 parts of deodorized tincture of opium, evaporated to 8 parts, 1 part of fluid extract of ipecac, and enough diluted alcohol to make 10 parts. It is designed to furnish Dover's powder in a liquid form. Ten minims represent a grain each of powdered opium and ipecac. The dose for an adult is 10 minims. Pill of ipecacuanha with squill, *pilula ipecacuanhæ cum scilla* (Br. Ph.), contains 3 parts of compound powder of ipecacuanha, 1 part of powdered squill, 1 part of powdered ammoniacum, and a sufficiency of treacle. The dose is from 5 to 10 grains.—HENRY A. GRIFFIN.

IPOMŒA.—See JALAP.

IRIDIN, or *irisin,* is an oleoresin obtained from the rhizome of *Iris versicolor.* It has been used as a *cholagogue cathartic* and as a *diuretic.* It may be given in doses of from 2 to 4 grains.

IRIS (U. S. Ph.) is the rhizome and roots of *Iris versicolor,* blue flag. It is *emetic, cathartic,* and *diuretic.* The dose of the powder is from 5 to 15 grains; that of the extract, *extractum iridis* (U. S. Ph.), from 1 to 2 grains; and that of the fluid extract, *extractum iridis fluidum* (U. S. Ph.), from 5 to 10 minims.

The *rhizoma iridis* of the Ger. Ph. is the rhizome of *Iris germanica, Iris pallida,* or *Iris florentina,* commonly known as orris root. It is seldom used as a medicament, but was formerly considered a useful *diuretic. Issne-peas* are made of the rhizome, but it is chiefly employed topically, in the form of powder, as an agreeable *desiccant* and as an ingredient of tooth powders.

IRISH MOSS.—See CHONDRUS.

IRISIN.—See IRIDIN.

IRON, *ferrum* (U. S. Ph., Br. Ph.), though employed in medicine mainly in the form of its salts, is considerably used in the metallic state, in the form of reduced iron, *ferrum reductum* (U. S. Ph., Ger. Ph.), *ferrum redactum* (Br. Ph.). Metallic iron, save of the reduced variety, is unsuited for internal administration, but for pharmaceutical purposes it is important, and therefore metallic iron is officially recognised. Iron, according to the Br. Ph., is represented by annealed iron wire, having a diameter of about 0·005 of an inch (about No. 35 wire gauge), or wrought-iron nails; free from oxide. The U. S. Ph. recognises iron as "metallic iron in the form of fine, bright, and non-elastic wire." In the Ger Ph. the metal is official only when pulverized, *fer-*

rum pulveratum (Ger. Ph.), being a fine, heavy, gray powder. Iron filings, *ferri ramenta* (U. S. Ph., 1850), too, were formerly official. Iron filings are objectionable, because in them the metal is almost invariably mixed with impurities, and, though the magnet has been used and still is used to separate the iron particles from the mixture, this procedure is no guarantee of purity, because, while some things may thus be separated, rust and dirt, which cling to the particles of iron, are practically inseparable and the filings still remain contaminated. It is highly important that all iron used in pharmacy shall be not relatively but absolutely pure, and for this reason the U. S. Ph. and the Br. Ph. are particular that official iron shall be in the form of wire, for softness and ductility are necessary for the manufacture of wire, and, since these qualities reside only in iron which is pure, the wire is necessarily pure. The use of wire was emphasized by the U. S. Ph. of 1850, for in it was *ferri filum*, iron wire, and yet it was this same pharmacopœia which recognised *ferri ramenta*, iron filings. If it was particular in one respect, it was certainly careless in another, and the *ferrum* of the present U. S. Ph. is a satisfactory name, provided it is understood to signify iron in the form of wire.

The origin of iron is too well known to require anything save the briefest consideration. It is the most plenteous of the metals, widely diffused throughout the earth, occurring not only in the mineral but also in the vegetable and animal kingdoms. It is extracted from iron ores, this name including those natural combinations of the metal which may be used with profit. The best iron is said to be obtained from the native oxide which is found particularly in Sweden, as well as in some portions of the United States. Iron has a slight odour when it is rubbed, and this odour is peculiar to the metal and characteristic of it. Its taste is slightly styptic. Iron, when brought to a white heat and exposed to air, burns with the emission of brilliant sparks. When it is brought to a red heat there forms upon its surface a crust of iron oxide. In its unheated condition its exposure to air and moisture results in another incrustation formed of hydrated sesquioxide of iron, and this is popularly known as iron rust. With acids iron forms salts many of which have an extended employment in medicine. Tannic acid combines with ferric salts in solution to produce a black colour, and therefore galls are used for the detection of the presence of iron. If the salt tested is not of the ferric variety it may previously be converted into this by boiling the solution containing the iron with nitric acid in small amount. The tannic-acid test is a very delicate one. Instead of galls, potassium ferrocyanide may be used for testing, the same things being requisite as in the tannin test. This, too, is a very delicate test, but the colour produced by it is a deep blue.

Since iron is a constant ingredient of the body, occurring not only in the blood but in the tissues generally, as well as in many of the healthy secretions, and since it also occurs in many of the foods upon which the body is nourished, it is certainly reasonable to regard iron rather as a food than as a medicine. Under ordinary circumstances of health the waste of iron is perfectly compensated for by the supply brought to the body in its ordinary food, but when, for various reasons, the amount of iron in the body is less than normal —it may be because the food contains an insufficiency of the metal, or because the natural absorption of iron is interfered with, or because there is an unusual loss of the metal, as is seen in anæmia from hæmorrhage—it becomes necessary to supply the deficiency and to give iron medicinally. In the broadest sense, such a bodily deficiency of iron is known as *anæmia*, and, since the iron of the body is present principally in the blood, it is to the condition of that fluid that we look for information of the supply of iron, and from examination of it we are guided as to the necessity of a greater or lesser supply of medicinal iron. Anæmia, in this sense, means iron deficiency, and it can be of little importance, therefore, what may be the cause of this deficiency; the state exists and an increased supply of iron to the body is demanded. The causes of this "poverty of the blood" are many. Debilitating diseases in general, prolonged discharges, cachexiæ, hæmorrhages, ill feeding, poor hygiene and bad habits, previous diseases, especially fevers, are thus operative, and, finally, unknown causes act to produce anæmic states which are often of much gravity, as seen in simple anæmia or chlorosis, pernicious anæmia, leucocythæmia, and Addison's disease.

Provided the cause of the anæmia is removable and removed, there results from the continued administration of a preparation of iron, in anæmic cases, a progressive increase in the quantity of hæmoglobin the blood contains, as well as in the number of its red cells, for, though the chemistry of the red cells is little known, it is nevertheless certain that iron is their most important mineral ingredient. Why the administration of iron should result in an increased production of red cells is another matter of which we are ignorant, and, since the origin and production of the red cells are as yet unexplained, the ignorance would seem likely to continue. The theory of von Noorden (*Berlin. klin. Woch.*, Mar. 4, 1895) is, however, interesting because of its ingenuity. His belief is that iron salts given in anæmia are simply irritants and stimulants to the hæmatopoietic organs and have no important chemical relation to the hæmoglobin. This theory is certainly at variance with beliefs long held, but in its support is the well-known fact that arsenic is competent to increase the number of the red cells, and yet is not an ingredient of hæmoglobin. This theory of von Noorden's is but one of a large number which have been advanced to explain the curative action of iron in anæmia, for with recent years there has been a growing disbelief in the former ideas which explained its action by absorption and direct conversion into an ingredient of hæmoglobin. It is not my purpose to enter into a discussion of these theories; the subject is too elaborate for a complete presentation, and the

confusion and contradiction which attend it are such as to invalidate any usefulness which might result from such a course. Some few things there are, however, which may briefly be mentioned, because they serve to show the unsettled condition of the subject at the present time.

Bunge, of Basel, has done about as much as anybody to disturb our previously accepted beliefs, for he thinks that iron, in inorganic combination, is not absorbed, and in this respect Kobert agrees with him. Bunge believes also that iron is absorbed only when combined with nucleoalbumin, and, finding in the yolk of eggs such a combination, he has termed it hæmatogen. This substance he finds plentiful in vegetables and scanty in milk. Vegetable diet he therefore recommends as a treatment for the anæmic, maintaining that the food is a sufficient provider of iron under all circumstances, while iron administered as is ordinarily done is efficient only by virtue of suggestion. Even iron in ordinary organic combination he thinks is not assimilated. The additional theory is advanced that, while the food contains a sufficiency of iron for the needs of the economy, in anæmia sulphuretted hydrogen is formed in the intestines, and combines with the iron of the food to form an insoluble sulphide, and thus an iron starvation results. Further, it is explained that, if iron in organic or inorganic combination is now given, the sulphuretted hydrogen unites with it and the iron in nucleoalbuminous combination is left free to perform its physiological function. This theory, though doubtless attractive, is certainly lacking in proof, for anæmia is not necessarily accompanied by intestinal putrefaction, and the invariable presence of hydrogen sulphide in the intestines of the anæmic remains to be demonstrated.

The non-absorption of salts of iron, as taught by Bunge, is flatly contradicted by A. B. Macallum (*Jour. of Phys.*, 3, 4, 1894; *Am. Jour. of the Med. Sci.*, Sept., 1894), who finds in physiological experimentation a sufficient reason for his belief. Kobert, too, adds to the confusion, though his belief seems reasonable, by expressing his conviction that vegetable foods are not so desirable for the anæmic as the animal foods are. These authorities, indeed, are but few as compared with the whole number who have held and expressed opinions upon this much-vexed topic. What wonder, then, that the reader is confused and unsettled and in his doubt falls back upon the simple and practical conclusion, in defiance of the opinion of Bunge, that iron is a desirable remedy for anæmia! That this is the general opinion it is not necessary to say, for when from the use of iron we find an increase in hæmoglobin and red cells, and when we see the colour return to the skin and mucous membranes, the muscular vigour increase, the digestion improve, the temperature perhaps rise, and the pulse grow strong, we have clinical evidence as to the value of the procedure which it takes more than "suggestion" to explain. No doubt a considerable part of the effectiveness of iron in anæmia is due to its local action upon the digestive organs, and especially the stomach, for it seems evident that increase of the tone and vigour of the stomach rapidly follows the internal administration of a chalybeate preparation which is not irritating. In short, iron must be regarded as a *stomachic* as well as a *general tonic*.

As iron is an ingredient of the larger number of our foods, it seems proper that in practice Nature should be imitated by giving iron after meals, and practically, too, this seems desirable, for, if given upon an empty stomach, the iron salts are frequently disturbing to the digestion instead of being, as they ought, stomachic. The stomachic action is lost, too, by the use of iron in unnecessarily large doses, and so far from producing benefit, in the haste to hurry in the needed iron, by its administration in such amounts we defeat our own end by causing digestive impairment. It is the same if the use of the remedy is too long continued or if it is given in health, for over-stimulation of the gastric follicles is the result and the stomach suffers. It is hardly reasonable to employ very large doses of iron for absorption and a tonic effect, for, apart from injury likely thereby to befall the stomach, it is probable that not more than a very small portion of the iron can by any possibility be absorbed, a large part of it being passed through the intestines and excreted in the fæces. A portion of that which is absorbed by the portal circulation is subsequently cast off in the bile, and of that which is taken up by the systemic circulation a part is undoubtedly excreted later by the urine. Small doses, or at least moderate ones, seem therefore the most appropriate when a tonic action is sought for.

So far as the most desirable preparations for its administration are concerned, opinions are as various as the theories of its absorption and action. By some the salts of iron which are soluble in water are thought to be the most suitable, but, since the experiments of Quevenne have shown that these salts are generally precipitated by the gastric juices, and, moreover, that they do not furnish so large an amount of the metal for absorption as the insoluble salts do, the preference for the soluble salts has grown less. As to the form in which iron is absorbed opinions differ, but the weight of opinion seems to incline to the albuminate. The seat of absorption is probably both in the stomach and in the small intestine. It would seem that the tonic power of iron preparations was largely determined subsequently to their absorption by the blood, and thus there seems less difference among the iron salts as to suitability, provided they are not positively undesirable because of a disturbing action upon the stomach. Quevenne has shown that the largest amount of iron for absorption is furnished by reduced iron, and Wood believes it to be the best form for administration, both because of this fact and also because of its freedom from astringency. So far as irritant properties are concerned, the per-salts are the most vigorous, and the iodide, chloride, nitrate, and sulphate in particular. Indeed, dangerous symptoms have resulted from their employ-

ment, and the tincture of ferric chloride has even caused death. These salts are also astringent to a greater degree than the other preparations of iron, and constipation is an ordinary result of their employment. On direct application in full strength they coagulate the blood and the tissues generally, and hence are used as hæmostatics. The teeth are blackened by the prolonged use of iron, and permanent and serious injury may come to them by the use of those vigorous preparations of which I have just spoken. Carried by the blood to the remote parts of the body, the metal acts locally upon them, serving to increase their tonicity and to excite their contractility, even to the astringent degree.

The importance of hæmoglobin, and therefore of iron, as an oxygen-carrier in the function of respiration is too familiar to require more than mention, but it is believed also that the hæmoglobin transforms the oxygen it takes up into its more active form, ozone. Iron is by this means thought to increase oxidation in the body, and the rise of temperature and the increase of urea cast off during a course of treatment with iron are thought to bear testimony to this ozonizing action of hæmoglobin.

The action of iron when given in health or for too long a time in disease, apart from its power to irritate the stomach, is to cause certain bodily disturbances, such as headache, which ordinarily are not pronounced. Yet it is said that plethora and its symptoms may thus arise, though it is difficult to see how they are produced, since the blood will assimilate no more than its normal maximum of iron. However this may be, an existing plethora is clearly a contra-indication to chalybeate treatment. Fever, too, is in general a contra-indication to the internal use of iron, because of the circulatory excitement which, to some degree, its use implies, and because of the increased oxidation it causes. Some few exceptions have been made to this febrile contra-indication, however, *erysipelas*, various forms of *amygdalitis*, and *pharyngitis* having been empirically treated with large doses of tincture of ferric chloride with some success.

Iron is eliminated in the fæces, in which it occurs as a sulphide, colouring them black, and yet of the iron contained in the fæces by far the greater part is probably not, strictly speaking, eliminated, but has merely passed unabsorbed through the intestines. The bile is thought to dispose of a certain amount of the iron absorbed by the portal system, and the urine in health contains iron from time to time; and this is increased while ferruginous treatment is being pursued.

These, then, are the considerations which apply to the iron preparations as a class, and to them the various salts of the metal in a general way conform. Certain differences in actions, uses, and applicability of course exist between them because of the characteristics which they derive from the materials with which the iron is combined. It seems desirable, therefore, to give to the various preparations some individual consideration, that completeness may not be sacrificed. As tonics these various salts and preparations all have this in common, that to be effective their use must be long continued, and even when a cure results they are more wisely removed by gradual reduction of the dose than by abrupt cessation. Moreover, occasional interruption in the chalybeate course is desirable, that digestive irritation may not occur, and occasional purgation is to be recommended during treatment by iron, for from it there occurs an augmentation of absorption and assimilation. Finally, all hygienic procedures should be enforced, and nourishing food, good air, and suitable exercise (in profoundly anæmic states absolute rest will at first conserve the vigour) should be provided as accessories to the tonic treatment.

Reduced iron, *ferrum reductum* (U. S. Ph., Ger. Ph.), *ferrum redactum* (Br. Ph.), powder of iron, iron by hydrogen, is a soft, light powder of iron-gray colour, with neither odour nor taste. It is permanent in dry air, but as ordinarily exposed it is very liable to oxidation, becoming black. It is therefore to be kept in a dry and well-stoppered bottle. It is insoluble in water and in alcohol. It is prepared by reducing ferric oxide by heating to dull redness and passing over it a stream of hydrogen gas. It is sometimes referred to as Quevenne's iron, but, unfortunately, the commercial specimens sold as Quevenne's iron are not always perfectly reduced iron. Perfectly reduced iron is one of the best, if not the best, form of iron to administer for its tonic action. It is well borne and free from irritating properties and astringency. It may be given in powder, pill, or lozenge, or mixed with chocolate. The dose is from 1 to 5 grains. Reduced-iron lozenges, *trochisci ferri redacti* (Br. Ph.), contain each 1 grain of reduced iron. The dose is from 1 to 6 lozenges. Aromatic mixture of iron, *mistura ferri aromatica* (Br. Ph.), is compounded with metallic iron, and therefore may be mentioned here. It is composed of 1 oz. of red cinchona bark, ½ oz. of calumba root, ¼ oz. of bruised cloves, ½ oz. of fine iron wire, 3 fl. oz. of compound tincture of cardamom, ½ fl. oz. of tincture of orange peel, and enough peppermint water to make 16 fl. oz. This preparation combines the therapeutic values of iron and quinine, but its chalybeate value is slight. It is an excellent *stomachic*, *tonic*, and *antiperiodic*. The dose is from 1 to 2 fl. oz. Wine of iron, *vinum ferri* (Br. Ph.), is mildly chalybeate. It is made with 1 part of iron wire and 20 fluid parts of sherry, and the product is a solution of iron and potassium tartrate. The dose is from 1 to 4 fl. drachms. This preparation should not be confounded with the *vinum ferri amarum* of the U. S. Ph., to be mentioned farther on.

Arsenate of iron, *ferri arsenias* (Br. Ph.), consists of "arseniates of iron with some oxide." It is an amorphous powder without odour or taste, of a greenish colour, and insoluble in water. It is dissolved by hydrochloric acid. Its action is that of arsenic, the amount of iron in a permissible dose being therapeutically insignificant. It is therefore not to be recommended when iron and arsenic

are demanded, for the extemporaneous combinations of iron and arsenic in mixture are far preferable. A combination of these two remedies which is much used contains 5 grains of the citrate of iron and quinine, 3 minims of solution of potassium arsenite, and 2 fl. drachms of orange-flower water to the dose. The main value of iron arsenate is in *anæmia* and in chronic skin diseases, especially those of a scaly character: for instance, *chronic eczema*, *psoriasis*, and *lepra*. It may be given in pill. The dose authorized by the Br. Ph. is from $\frac{1}{16}$ to $\frac{1}{8}$ of a grain, but the latter dose is excessive and a dose of $\frac{1}{8}$ of a grain should not be exceeded. The salt, mixed with simple cerate (1 to 12), is occasionally applied to *ulcerating carcinomata*, but the practice is not free from danger.

Iron Carbonate.—Saccharated carbonate of iron, saccharated ferrous carbonate, *ferri carbonas saccharatus* (U. S. Ph.), *ferri carbonas saccharata* (Br. Ph.), *ferrum carbonicum saccharatum* (Ger. Ph.), according to the Br. Ph., is "carbonate of iron, $FeCO_3+H_2O$, mixed with peroxide of iron and sugar, the carbonate (if reckoned as anhydrous) forming about one third of the mixture." It occurs in powder as well as in lumps. Its colour is grayish brown or greenish brown; it is odourless, but has a taste which is saccharine at first, later styptic. It is but partially soluble in water, though freely soluble in hydrochloric acid, with which it effervesces. The amount of ferric oxide in this preparation makes it undesirable as compared with Vallet's mass, in which oxidation is less complete, because of the earlier incorporation of sugar in it. Nevertheless, it is an efficient preparation for tonic use and is much employed. It is given in pill. The dose is from 5 to 30 grains. Mass of ferrous carbonate, Vallet's mass, *massa ferri carbonatis* (U. S. Ph.), is a soft pilular mass, of a dark-green colour which on exposure becomes black. Its taste is ferruginous. As it contains nearly half its weight of ferrous carbonate, its medicinal superiority over the saccharated carbonate of iron is readily seen. Vallet's mass is an excellent preparation for eliciting the tonic action of iron. It is not astringent and is well borne. It is useful in *anæmia* and *chlorosis*. It is given in pill form. The dose is from 3 to 5 grains. Similar to Vallet's mass is the pill of carbonate of iron, *pilula ferri carbonatis* (Br. Ph.), which contains 4 parts of saccharated carbonate of iron and 1 part of confection of roses, but its efficiency is not greater than that of the saccharated carbonate from which it is made, and probably it is not so great. The dose is from 5 to 20 grains. Pills of carbonate of iron, *pilulæ ferri carbonatis* (U. S. Ph.), are, however, quite different in composition from the British pill of like name. The confusion thus caused is as unfortunate as it is unnecessary, but little practical harm has resulted, for the name by which the American preparation is most commonly known is Blaud's pills, less often ferruginous pills or chalybeate pills. The composition of Blaud's pill is 16 parts of ferrous sulphate, 8 parts of potassium carbonate, 4 parts of sugar, 1 part of tragacanth, 1 part of powdered althæa, and a sufficient quantity of glycerin and water. This pill is an efficient tonic and is much employed. Its activity is dependent upon the ferrous carbonate generated by the mixture of its ingredients, and, as this is changed to a ferric salt upon exposure, the mass should be freshly compounded, when needed. The pill ordinarily given contains 5 grains of the mass. The dose is from 1 to 6 pills. These pills bear a close resemblance to compound iron mixture, or Griffith's mixture, in action and composition, and are sometimes known as Griffith's pills. They differ from the original ferruginous pill of Blaud, which contained equal parts of ferrous sulphate and potassium carbonate made up with mucilage of tragacanth and powdered licorice root. By some, sodium bicarbonate is preferred to the potassium carbonate in the manufacture of these pills, and this preference is exhibited in the Ger. Ph., whose iron pills, *pilulæ ferri carbonici* (Ger. Ph.), contain the sodium salt. It would seem that of the preparations of iron carbonate there is more than a sufficiency, but it must be remembered that the salt is one whose usefulness in all forms of anæmia is pronounced. It is non-irritating, little astringent, well borne, and highly efficient. By many, indeed, the carbonate is more esteemed than all other salts of iron for the purposes indicated. The number of its preparations is therefore, perhaps, not unreasonable. Compound iron mixture, *mistura ferri composita* (U. S. Ph., Br. Ph.), Griffith's mixture, is an excellent form in which to administer ferrous carbonate, though it is not identical with the original anthectic mixture of Griffith. According to the U. S. Ph., it contains 6 parts of ferrous sulphate, 18 each of myrrh and sugar, 8 of potassium carbonate, 60 of spirit of lavender, and a sufficient quantity of rose water to make 1,000 parts. The composition of the British preparation is very similar. Because of the myrrh it contains it has a special value in the *anæmia* which accompanies *menstrual irregularities*. It is beneficial in the *hectic* conditions of debilitating disease, and is efficient in *digestive atony*, though contra-indicated by actual inflammation of the stomach. The dose is from 1 to 2 fl. oz.

Iron Chloride.—Ferric chloride, *ferri chloridum* (U. S. Ph.), *ferrum sesquichloratum* (Ger. Ph.), chloride of iron, perchloride of iron, sesquichloride of iron, is formed by heating iron wire with hydrochloric acid and converting the ferrous chloride thus produced into ferric chloride by heating it with hydrochloric and nitric acids. The formula of ferric chloride is $Fe_2Cl_6+12H_2O$. It occurs as orange-yellow crystals, usually without odour, but of styptic taste. It is deliquescent in moist air and very soluble in water and in alcohol. Ferric chloride itself has no medicinal employment, but solutions which vary in strength have been used as *coagulants* for the treatment of *aneurysms* and *varices*. Solution of ferric chloride, *liquor ferri chloridi* (U. S. Ph.), *liquor ferri perchloridi* (Br. Ph.), solution of perchloride of

iron, *liquor ferri sesquichlorati* (Ger. Ph.), solution of iron sesquichloride, is an aqueous solution of ferric chloride. The strength of the British preparation is less than that of the U. S. Ph. solution, as is shown by a comparison of their specific gravities, that of the Br. Ph. being 1·110 while that of the U. S. Ph. is 1·387. The Br. Ph., however, recognises a strong solution of perchloride of iron, *liquor ferri perchloridi fortior* (Br. Ph.), which more nearly resembles the U. S. Ph. solution, though it slightly exceeds it in strength, its specific gravity being about 1·420. The relation in strength between the two British solutions is as 1 to 4, and the strength of the weaker solution is identical with that of the British tincture of perchloride of iron, *tinctura ferri perchloridi*. The stronger solution of the Br. Ph. is less used for internal administration than the weaker solution, of which the dose is from 10 to 30 minims. If properly diluted it may be given internally in doses somewhat smaller than those of the U. S. Ph. solution, which range from 2 to 10 minims. The internal uses of the solutions of ferric chloride do not differ from those of the tincture, save in so far as they may be preferred because of their non-alcoholic nature. Externally, the solutions of iron chloride have been employed as *styptics* and *coagulants*. For *post-partum hæmorrhage*, if diluted in the proportion of from 1 fl. drachm to ½ fl. oz. to the pint, the U. S. Ph. solution may be introduced into the cavity of the uterus, but the practice is not to be commended. Coagulation in *soft vegetations* and *growths* and their subsequent destruction may be effected by the application of ferric-chloride solution. Thus have been cured *polypi* and *redundant ulcerations*. For the arrest of *hæmorrhage* the local application of solution of ferric chloride is certainly efficient, though ordinarily to be avoided because the procedure is in violation of the aseptic treatment of wounds. These solutions have been injected into *aneurysms*, *varices*, and *nævi* in the expectation of causing coagulation in them and obliteration. Success has followed the practice in some cases, it is true, but so has death, and embolism is greatly to be feared. Tincture of ferric chloride, *tinctura ferri chloridi* (U. S. Ph.), *tinctura ferri perchloridi* (Br. Ph.), tincture of perchloride of iron, tincture of sesquichloride of iron, according to the Br. Ph. corresponds in strength with to its solution of ferric chloride, and the dose is the same as the dose of that solution—from 10 to 30 minims. It should be kept at least three months before being used. The tincture of ferric chloride of the U. S. Ph. is approximately of the same ferruginous strength as the British tincture, for it is composed of 25 parts of solution of ferric chloride in enough alcohol to make 100 parts. It is far stronger in alcohol, however, than the British tincture. The dose is from 10 to 30 minims. Ethereal tincture of ferric chloride, *tinctura ferri chlorati ætherea* (Ger. Ph.), is of similar composition, containing 1 part of solution of iron sesquichloride, 2 parts of ether, and 7 parts of alcohol. The tincture of ferric chloride is much employed. In *anæmia* and *chlorosis* it is certainly an efficient preparation, and, though it is astringent and vigorous even to the irritating degree, these very facts seem to make it a desirable form in which to administer iron when digestive atony is present, as is so often the case. It is, however, a fact that the "tincture of iron" is ill borne in many cases, and then it becomes necessary to replace it with a preparation of greater mildness. In *albuminuria* of chronic type and in *chronic Bright's disease* tincture of ferric chloride is much employed, and is beneficial by virtue of its action to enrich the blood, which is generally impoverished in these conditions, to improve digestion, and perhaps to occasion constriction of the renal vessels; moreover, it is diuretic. The tincture is useful in various exudative conditions of chronic type, such as *gleet*, *prostatorrhœa*, *spermatorrhœa* due to local relaxation, and *chronic bronchitis*; and *emphysema* is benefited by it if anæmia is present. It is said to have a special activity upon the urinary tract. In the presence of plethora it is of course contra-indicated. *Passive hæmorrhages* are benefited by the tincture of ferric chloride if anæmia is present, and especially *epistaxis*, *purpura*, and *bleeding from the stomach*, *kidneys*, *uterus*, *bladder*, or *bowels*. In *hæmoptysis* iron is generally contra-indicated. Tincture of chloride of iron will in the anæmic be prophylactic against *rheumatism* and may be given in suitable cases upon the slightest intimation of rheumatic symptoms. In the rheumatic tendency or manifestations of the plethoric, iron is positively injurious. Some have recommended the use of tincture of ferric chloride in *acute articular rheumatism*. In spite of the contra-indication of the fever, it is often of the utmost value in anæmic cases, and, indeed, without some form of iron other treatment may be either relatively or positively useless. Since the rheumatic poison is undoubtedly productive of anæmia, iron in some form will almost always be required after a severe rheumatic attack, and its administration may be begun before the full development of convalescence, provided the blood condition of the patient should demand it. *Erysipelas* has often been treated by the administration of tincture of ferric chloride in large doses, and for empirical reasons. The practice is of doubtful utility, for the indication is clearly for local antisepsis and such antipyretic and supporting treatment as may be required. In erysipelas the dose of tincture of chloride of iron is from 10 to 40 minims every three or four hours. *Diphtheria* is treated in the same way and with the same lack of reason. In some cases, however, the practice seems of good effect, though the local application of the diluted tincture to the site of the inflammation (the dilution should always reduce the strength of the tincture at least one half) seems more rational, and is often effective. When given internally for diphtheria, the tincture is often combined with potassium chlorate. The use of the tincture alone or in combination for diphtheria is now less frequent than formerly, and mainly because in the diphtheria antitoxine we now have a remedy which is not only reasonable but

effective. In other forms of *sore throat*, catarrhal as well as croupous, the tincture may be given internally or may be more advantageously applied locally. In using ferric chloride internally or for application about the mouth and throat it must be remembered that its corrosive action upon the teeth is extreme, and care must be taken to prevent its contact with them or to cleanse them at once with an alkali. The iron should invariably be given largely diluted. The internal use of tincture of ferric chloride has also been recommended and tried for other febrile affections, *scarlatina*, *pyæmia*, and *septicæmia* in particular, but the practice has met with little success. *Typhoid fever* has been treated by the administration of tincture of iron perchloride in 5-drop doses given hourly in water and glycerin. It is alleged that a fall of temperature and the cessation of diarrhœa are rapidly accomplished, and that recovery is almost invariable if the treatment is begun before the case has become grave. General experience, however, does not support these statements, and the remedy is not to be recommended in enteric fever. In *neurotic disturbances* which depend upon anæmia, in *hysteria*, in *melancholia*, and even in *mania*, the tincture of iron is an excellent remedy. In the *neuralgias of anæmia* it is also beneficial. In short, in *cachexia*, *debility*, and *anæmic conditions* in general, which may or may not be accompanied by other and more active manifestations of disease, the tincture of ferric chloride is an excellent preparation if it is tolerated by the stomach. In *leucocythæmia* iron is usually of little value, but in *pseudoleucæmia* the tincture of ferric chloride may be beneficial. The tincture is occasionally used locally as a styptic application to *ulcerations* and has been injected into *aneurysms* and *varicosities* with success, but not without risk.

Ammonio-chloride of iron, ammoniated iron, *ammonium chloratum ferratum* (Ger. Ph.), occurs in reddish crystalline grains of saline and styptic taste. It is deliquescent and very soluble in water. It is slightly laxative. It has been recommended especially for *rickets*, *scrofula*, and *amenorrhœa*. The dose is from 3 to 10 grains.

Iron sulphate, ferrous sulphate, *ferri sulphas* (U. S. Ph., Br. Ph.), *ferrum sulfuricum* (Ger. Ph.), $FeSO_4+7H_2O$, is sometimes known as green vitriol. It occurs in large crystals of a blue-green colour, without odour, and of a saline and astringent taste. It is efflorescent in dry air. In moist air the crystals absorb oxygen and become covered by a layer of ferric sulphate. It is freely soluble in water, but insoluble in alcohol. Ferrous sulphate of the impure variety (the copperas of commerce), *ferrum sulfuricum crudum* (Ger. Ph.). is much employed as a disinfectant. (See DISINFECTANTS.) The purified variety, which is the one described as ferrous sulphate, or sulphate of iron. is considerably employed in medicine, and in physiological and therapeutical activity it closely resembles iron chloride, being an energetic *astringent* and in large doses irritant, even to the extent of causing gastro-enteric inflammation. In the *gastric atony of anæmia* this salt is a superior one, unless, as sometimes happens, it is too irritant to be tolerated. In *anæmic* and *debilitated conditions associated with chronic discharges* it is thought to be desirable because of its astringency. Among these conditions *chronic diarrhœa*, *bronchitis*, *colliquative sweats*, *gleet*, and *passive hæmorrhages* may be cited as examples. Its tendency to constipate is considerable, and therefore laxatives are often wisely combined with it. Solutions of iron sulphate varying in strength from 1 to 10 grains to 1 oz. are considerably employed as *astringents* in conditions of local relaxation, among them *chronic ophthalmia* and *gleet*. The dose of ferrous sulphate is from 1 to 5 grains. Granulated sulphate of iron, granulated ferrous sulphate, *ferri sulphas granulatus* (U. S, Ph.), *ferri sulphas granulata* (Br. Ph.), is a more minutely divided ferrous sulphate occurring as a pale, bluish-green, crystalline powder. Its other characteristics are those of ferrous sulphate. It is official because it is less liable to oxidation than the ordinary sulphate and is convenient in dispensing. Its dose is from 1 to 5 grains. Dried ferrous sulphate, dried sulphate of iron, *ferri sulphas exsiccatus* (U. S. Ph.), *ferri sulphas exsiccata* (Br. Ph.), *ferrum sulfuricum siccum* (Ger. Ph.), is ferrous sulphate deprived of a portion of its water of crystallization by the action of heat. Its formula is approximately $2FeSO_4+3H_2O$. In pharmacy it appears as a grayish-white powder. It is soluble in water. Its uses are those of crystallized ferrous sulphate, but it is employed in place of that salt because of its suitability for incorporation in pills. The dose is somewhat smaller than that of the crystallized sulphate, from ½ to 2 grains being appropriate. Ferric ammonium sulphate, ammonio-ferric alum, *ferri et ammonii sulphas* (U. S. Ph.), occurs in pale violet crystals without odour and of an acid, astringent taste. It is efflorescent on exposure. It is freely soluble in water, but insoluble in alcohol. The dose is from 5 to 10 grains. It is useful as a *chalybeate astringent*, and a saturated solution is valuable as a *styptic*. Pills of aloes and iron, *pilulæ aloes et ferri* (U. S. Ph.), *pilula aloes et ferri* (Br. Ph.), *pilulæ alocticæ ferratæ* (Ger. Ph.), are a desirable preparation for *anæmia accompanied by constipation*. If *amenorrhœa* is also present they are especially indicated. The pill of the U. S. Ph. contains about 1 grain each of purified aloes, dried ferrous sulphate, and aromatic powder, with a sufficient quantity of confection of rose. The dose is from 1 to 3 pills. The pill of the Br. Ph. contains 1½ part of sulphate of iron, 2 parts of Barbadoes aloes, 3 parts of compound powder of cinnamon, and 4 parts of confection of roses. The dose is from 5 to 10 grains. Solution of ferric subsulphate, *liquor ferri subsulphatis* (U. S. Ph.), Monsel's solution, is an aqueous solution of basic ferric sulphate containing about 13·6 per cent. of metallic iron. It is a reddish-brown liquid of styptic taste. It is miscible with water in all proportions. Evaporated by heat, it produces ferric subsulphate, or Monsel's salt.

The salt is less irritating than ferric sulphate and equally astringent. The salt itself may be used as an *astringent*, a suppository containing 2 grains being excellent for *hæmorrhoids*, but the solution is more frequently employed. The chief use of the solution is as a styptic application in *hæmorrhage*. In external hæmorrhage, as from *leech bites*, *oozing from wounded surfaces*, etc., the application may be made of the undiluted solution. In *post-partum hæmorrhage* it has been applied, diluted, to the uterine cavity. In *hæmatemesis* 10 drops may be given in ½ oz. of water and repeated as may be necessary. In *hæmoptysis* it may be used by atomization and inhalation of a solution containing from 5 to 20 drops to 1 oz. of water. The inhalation should last five or ten minutes and be repeated at intervals of a few hours. The pure solution may be applied for the destruction of *syphilitic* and other *venereal vegetations*. Applied undiluted to the seat of the inflammation in *acute follicular amygdalitis*, Monsel's solution will promptly act to constringe the inflamed tissues and promote recovery. In such cases the application may be made twice daily, and a mildly astringent gargle, as of potassium chlorate, may be used in the intervals. Solution of ferric sulphate, solution of persulphate of iron, *liquor ferri tersulphatis* (U. S. Ph.), *liquor ferri persulphatis* (Br. Ph.), is a dark, reddish-brown liquid without odour, of a strongly styptic taste. It is miscible with water in all proportions. This solution is rarely employed in medicine, on account of its irritant nature. Its use in pharmacy, however, is important, since from it is made the arsenical antidote, ferric hydrate.

Iron citrate, *ferri citras* (U. S. Ph.), *ferrum citricum oxydatum* (Ger. Ph.), occurs in thin scales of a crimson colour, without odour, and of a ferruginous taste. It is slowly soluble in cold water, but readily soluble in hot water. It is insoluble in alcohol. The salt is a mild and efficient *chalybeate tonic*. The dose is from 3 to 5 grains. It is usually administered as the solution of ferric citrate, *liquor ferri citratis* (U. S. Ph.). This is an aqueous solution of ferric citrate containing about 7·5 per cent. of metallic iron. The dose is 10 minims, equivalent to 5 grains of the salt. Wine of ferric citrate, wine of citrate of iron, *vinum ferri citratis* (U. S. Ph., Br. Ph.), according to the U. S. Ph., is composed of 4 parts of iron and ammonium citrate, 15 of tincture of sweet-orange peel, 10 of syrup, and enough white wine to make 100 parts. The dose is 1 fl. drachm, which contains about 2½ grains of the iron salt. The British preparation contains 1 part of citrate of iron and ammonium and nearly 55 parts of orange wine. The dose is from 1 to 4 fl. drachms.

Iron and ammonium citrate, citrate of iron and ammonium, *ferri et ammonii citras* (U. S. Ph., Br. Ph.), occurs in thin, transparent crimson scales, without odour, but of a saline and ferruginous taste. It is deliquescent in moist air and freely soluble in water. It is insoluble in alcohol. It is a mild preparation and suitable for *anæmias* in general. The dose is 5 grains, given in solution, the salt being unsuitable for pill formation.

Iron and quinine citrate, citrate of iron and quinine, *ferri et quininæ citras* (U. S. Ph., Br. Ph.), *chininum ferro-citricum* (Ger. Ph.), occurs in thin scales of a reddish-brown colour and a bitter, chalybeate taste. It is somewhat deliquescent in moist air, slowly soluble in cold water, readily soluble in hot water, and little soluble in alcohol. This salt is much used as a *tonic* and is especially useful in *anæmia of malarial origin*. It is mild in its action and may advantageously be used in combination with arsenic. The dose is 5 grains, and this contains about ½ a grain of quinine. The dose may be increased if necessary. The salt is generally given in pill, since it is somewhat slow of solution. Soluble iron and quinine citrate, *ferri et quininæ citras solubilis* (U. S. Ph.), is designed to overcome this objection to the ordinary salt, the addition of a small quantity of ammonia water to the usual formula for making iron and quinine citrate rendering it easily soluble. It occurs in thin, transparent scales of a greenish-yellow colour. Its properties, save that of solubility, are practically the same as those of iron and quinine citrate, and the uses of the two are identical. Bitter wine of iron, *vinum ferri amarum* (U. S. Ph.), contains 5 parts of soluble iron and quinine citrate, 15 of tincture of sweet-orange peel, 30 of syrup, and enough white wine to make 100 parts. The dose is from 2 to 4 fl. drachms. It is used as a mild *tonic*.

Iron and strychnine citrate, *ferri et strychninæ citras* (U. S. Ph.), contains 98 parts of iron and ammonium citrate, 1 part each of strychnine and citric acid, and enough distilled water to make 100 parts. It appears as thin, transparent scales which vary in colour from crimson to yellowish-brown and are of a bitter and ferruginous taste. It is deliquescent in damp air and freely soluble in water, but only partly soluble in alcohol. As a *tonic* it combines the virtues of iron and strychnine. The dose is from 3 to 5 grains, given in pill or solution. Five grains contain $\frac{1}{20}$ of a grain of strychnine (1 per cent.).

Iron Acetate.—Solution of acetate of iron, solution of ferric acetate, *liquor ferri acetatis* (U. S. Ph., Br. Ph.), *liquor ferri acetici* (Ger. Ph.), according to the U. S. Ph., is "an aqueous solution of ferric acetate ($Fe_2(C_2H_3O_2)_6$) containing about 31 per cent. of the anhydrous salt, and corresponding to about 7·5 per cent. of metallic iron." It is a reddish-brown liquid of sharp odour and of a sweetish, acid, and styptic taste. The dose is from 2 to 10 minims. The British solution is of the same strength as the British tincture of acetate of iron. It is composed of 1 part of strong solution of acetate of iron and 3 parts of distilled water. The dose is from 5 to 30 minims. Strong solution of acetate of iron, *liquor ferri acetatis fortior* (Br. Ph.), is about the same as the solutions of iron acetate of the U. S. Ph. and the Ger. Ph., though somewhat weaker. It is a deep-red fluid of acetous odour and sour, styptic taste. The dose is from 1 to 8 minims, but it is used principally in pharmacy, to make

the weaker solutions of iron acetate. Tincture of acetate of iron, *tinctura ferri acetatis* (Br. Ph.), contains 5 parts of strong solution of acetate of iron, 1 part of acetic acid, 5 parts of rectified spirit, and 9 parts of distilled water. The dose is from 5 to 30 minims. It is a mild chalybeate. Its German similar is the ethereal tincture of iron acetate, *tinctura ferri acetici œtherea* (Ger. Ph.). A tincture of iron acetate was formerly official in the U. S. Ph., but was dropped in the revision of 1890.

Solution of iron and ammonium acetate, *liquor ferri et ammonii acetatis* (U. S. Ph.), Basham's mixture, is compounded of 2 parts of tincture of ferric chloride, 3 of diluted acetic acid, 20 of solution of ammonium acetate, 10 of aromatic elixir, 12 of glycerin, and enough water to make 100 parts. The dose is from ½ to 1 fl. oz. The preparation is an excellent one, is *tonic* and *astringent*, and is used much in *chronic nephritis.*

Iron Iodide.—Saccharated ferrous iodide, *ferri iodidum saccharatum* (U. S. Ph.), is ferrous iodide preserved by sugar of milk. It occurs as a yellowish or grayish powder without odour, of a sweetish, ferruginous taste, and very hygroscopic. It is soluble in water, but only partly soluble in alcohol. The dose is from 2 to 5 grains. Pills of iodide of iron, *pilulœ ferri iodidi* (U. S. Ph.), *pilula ferri iodidi* (Br. Ph.), are also known as Blancard's pills. Each pill, according to the U. S. Ph., contains about 1 grain of ferrous iodide and ⅛ of a grain of reduced iron. The dose is from 1 to 3 pills. According to the British formula, the composition of this pill is 4 parts of fine iron wire, 8 of iodine, 7 of refined sugar, 14 of licorice root, and 4·6 of distilled water. The dose is from 3 to 8 grains. Syrup of iodide of iron, syrup of ferrous iodide, *syrupus ferri iodidi* (U. S. Ph., Br. Ph.), *sirupus ferri jodati* (Ger. Ph.), is a solution of ferrous iodide made more lasting by the use of sugar. It is much employed as a *tonic* and *alterative*, as are the other preparations of iodide of iron. *Emmenagogue* virtues have been ascribed to ferrous iodide, as well as diuretic power. The syrup is by all means the most valuable and useful preparation of the salt, and is much employed. The diseases most benefited by it are *scrofula* and *glandular enlargements, chlorosis, anœmia, atonic amenorrhœa,* and *atony of mucous surfaces with resultant discharges. Syphilis with anœmia and debility* is much benefited by ferrous iodide. The syrup is especially useful for children, and is given with advantage in combination with cod-liver oil. It is often valuable to promote diminution in *adenoid vegetations of the pharynx* and to relieve *nocturnal enuresis* in children. It is an excellent tonic in *debility* occurring in children. The dose of the U. S. Ph. syrup for an adult is from 15 to 30 minims. The British syrup contains 4·3 grains of iodide of iron in 1 drachm. The dose is from ½ to 1 fl. drachm. A solution of iodide of iron, *liquor ferri jodati* (Ger. Ph.), is also in use.

Iron Phosphates and Phosphites.—Ferric hypophosphite, *ferri hypophosphis* (U. S. Ph.), is a white or grayish powder, without odour and with little taste, very little soluble in water, but soluble in a solution of hypophosphorous acid. The dose is from 5 to 10 grains, given in powder or in pill. It is thought useful in *anœmia with cerebral debility.* (See HYPOPHOSPHITES.) Syrup of hypophosphites with iron, *syrupus hypophosphitum cum ferro* (U. S. Ph.), contains in each drachm ⅘ of a grain of ferrous lactate. The dose is from 1 to 2 fl. drachms. (See HYPOPHOSPHITES.)

Phosphate of iron, *ferri phosphas* (Br. Ph.), contains ferrous phosphate, at least 47 per cent., with ferric phosphate and some oxide. It occurs as an amorphous powder of slate-colour, insoluble in water, but soluble in acids. It is useful as a mild chalybeate. The dose is from 5 to 10 grains. Soluble ferric phosphate, *ferri phosphas solubilis* (U. S. Ph.), is entirely different from the British preparation just described, and in fact is a mixture of various ingredients, and not purely iron phosphate. It occurs in thin, transparent scales of a bright-green colour, no odour, and an acid, saline taste. It is soluble in water, but insoluble in alcohol. The dose is from 2 to 5 grains. Syrup of phosphate of iron, *syrupus ferri phosphatis* (Br. Ph.), contains the equivalent of about 1 grain of anhydrous phosphate of iron in 1 fl. drachm. The dose is 1 fl. drachm. Syrup of the phosphates of iron, quinine, and strychnine, *syrupus ferri quininœ et strychninœ phosphatum* (U. S. Ph.), contains in each fl. drachm about 1 grain of ferric phosphate, 1⅘ grain of quinine, and $\frac{1}{60}$ of a grain of strychnine. The dose is about 1 fl. drachm. Soluble ferric pyrophosphate, *ferri pyrophosphas solubilis* (U. S. Ph.), occurs in thin, transparent scales of an apple-green colour, no odour, and acid, saline taste. It is freely soluble in water, but not in alcohol. The dose is from 2 to 5 grains. It is an excellent chalybeate of mild action and may be given in solution or in pill.

Iron Lactate.—Ferrous lactate, *ferri lactas* (U. S. Ph.), *ferrum lacticum* (Ger. Ph.), occurs as pale, greenish-white crystalline crusts, of slight odour and a sweet, chalybeate taste. It is soluble in water, though slowly. The salt is useful in *chlorosis* and has been much employed in France. The dose is from 1 to 5 grains. It may be given in pill, lozenge, or syrup, and has even been incorporated with bread in the proportion of about 1 grain to 1 oz. This is called *chalybeate bread.*

Iron Nitrate.—Solution of ferric nitrate, *liquor ferri nitratis* (U. S. Ph.), *liquor ferri pernitratis* (Br. Ph.), solution of pernitrate of iron, is an aqueous solution of ferric nitrate. The U. S. Ph. preparation contains about 6·2 per cent. of the anhydrous salt; the Br. Ph. preparation is of about twice that strength. The dose of the American solution is from 5 to 15 minims, and, though it is scarcely reasonable, the dose of the English preparation, according to the Br. Ph., is from 10 to 40 minims. Although the solution is *tonic,* it has been used mainly as an astringent in *chronic diarrhœas.* In some cases it does good, but in others it is unduly irritating. It has been thought to benefit *menorrhagia* and *leucor-*

rhœa in the anæmic and atonic, when given by mouth, and in the latter condition has also been used as an injection, the solution having been diluted so that nothing beyond slight smarting in the vagina was produced.

Iron Tartrate.—Iron and ammonium tartrate, *ferri et ammonii tartras* (U. S. Ph.), ammonio-ferric tartrate, occurs in thin, transparent scales of a reddish or brownish colour, no odour, and a sweetish, ferruginous taste. It is very soluble in water and slightly deliquescent in the air. It is insoluble in alcohol. It is a mild chalybeate *tonic*. The dose is from 10 to 30 grains. Iron and potassium tartrate, *ferri et potassii tartras* (U. S. Ph.), potasso-ferric tartrate, tartrated iron, *ferrum tartaratum* (Br. Ph.), occurs in thin, transparent scales of a reddish colour, no odour, and a sweetish, astringent taste. It is soluble in water, but not in alcohol. The dose is from 5 to 10 grains. The salt is a mild and unirritating chalybeate *tonic*, and is given generally in solution. It is but slightly astringent, is not disagreeable to the taste, and may well be given to children.

Iron Valerianate.—Ferric valerianate, *ferri valerianas* (U. S. Ph.), occurs as a dark-red amorphous powder, with an odour resembling that of valerian and an astringent taste. It is insoluble in cold water, but soluble in alcohol. The dose is from 1 to 5 grains. It is useful in *anœmia* associated with *hysterical disturbances*, and is said to be remarkably efficient in *diabetes insipidus*.

Iron Hydrate.—Ferric hydrate, *ferri oxidum hydratum* (U. S. Ph.), peroxide of iron, *ferri peroxidum hydratum* (Br. Ph.), ferric hydroxide, sesquioxide of iron, is a reddish-brown mass without taste. The British preparation, however, is a powder, the moisture having been removed by heating and the mass pulverized. As a chalybeate, ferric hydrate is little employed; troches, *trochisci ferri* (U. S. Ph.), are, however, in occasional use. Each troche contains about 5 grains of ferric hydrate. The dose is from 1 to 6 lozenges. Ferric hydrate is used also for external application, iron plaster, chalybeate plaster, or strengthening plaster, *emplastrum ferri* (U. S. Ph., Br. Ph.), being the form employed. This plaster contains about 1 part of ferric hydrate with 2 parts of Burgundy pitch and 8 parts of lead plaster, olive oil being an additional ingredient of the American preparation. Its local strengthening action is certainly more fancied than real and is explicable, if it exists, on protective and mechanical grounds, for no absorption of its active ingredients takes place. It is used in *myalgic* conditions. By far the most important use of ferric hydrate is as an antidote to arsenic, and for use in cases of *poisoning by arsenic* the remedy must be freshly prepared. For this reason apothecaries should, and generally do, keep the ingredients necessary for its precipitation constantly made up. According to the Br. Ph., these ingredients are 4 fl. oz. of solution of persulphate of iron, 33 fl. oz. of solution of soda, and a sufficient amount of distilled water. The iron solution is mixed with a pint of the water and is added to the soda solution, with constant stirring. The mixture is allowed to stand for two hours, with occasional stirring, and is then filtered on calico, the precipitated ferric hydrate being washed with distilled water until the washings cease to give a precipitate with barium chloride. In arsenical poisoning no such leisure in preparation is allowable, and the filtration and precipitation must be done rapidly. The process of the U. S. Ph. is similar, save only that ammonia water is employed to cause precipitation of the ferric hydrate. The ingredients recommended by the U. S. Ph. to be kept on hand are 200 c. c. of solution of ferric sulphate, 220 c. c. of ammonia water, and a sufficiency of water. The antidote, especially when hastily prepared, contains ammonia, and, though by some this is believed to assist in the antidotal action, it seems evident that it can not be free from irritant effect, and for this reason ferric hydrate precipitated by magnesia is preferable, because magnesia is positively antidotal and certainly harmless, and therefore the fresh precipitate may at once be given to a person suffering from arsenical poisoning, and without the elaborate washing of the precipitate which is required in the use of ammonia as a precipitant. This magnesian precipitate is known as ferric hydrate with magnesia, *ferri oxidum hydratum cum magnesia* (U. S. Ph.), arsenic antidote. The directions for preparing this antidote, according to the U. S. Ph., are to mix 50 c. c. of solution of ferric sulphate with 100 c. c. of water and keep the liquid in a large bottle, well stoppered; to rub 10 grammes of magnesia with cold water to a smooth, thin mixture and place it in a bottle of 1,000 c. c. capacity, filling up with water to three fourths its capacity. When the antidote is wanted the magnesia mixture must be shaken to a homogeneous, thin magma and added to the iron solution, and both shaken until a smooth mixture results. In an emergency solution of ferric chloride may be substituted for the ferric sulphate, and sodium carbonate for the ammonia or magnesia. No stated dose can be assigned to the arsenical antidote. The preparation should be given freely, since it is innocuous and is inefficient if not used in excess. If the stomach-tube can be employed it is an excellent plan to wash the stomach out, using the antidote for the purpose. If given in the ordinary way, the dose may be stated as in the neighbourhood of ½ fl. oz., repeated frequently.

Dialyzed iron has also been used as an antidote in a similar way and in the same doses, but some doubt as to its reliability exists, because in the presence of acids it is said to part with the arsenic it has taken up. A solution of dialyzed iron, *liquor ferri dialysatus* (Br. Ph.), is at times employed as a chalybeate. It is a reddish-brown liquid of little taste. The dose is from 10 to 30 minims. In Germany this solution is known as *liquor ferri oxychlorati* (Ger. Ph.).

Iron Oxide.—Saccharine oxide of iron, *ferrum oxydatum saccharatum* (Ger. Ph.), has been highly spoken of as an arsenical antidote, acting as ferric hydrate does, by forming an insoluble compound with arsenic. It has been

given in doses of 1 drachm mixed with water and administered every quarter of an hour for several hours. An emetic should also be used.

Magnetic iron oxide, *ferri oxidum magneticum*, as artificially prepared, is a dark-brown powder without taste and strongly magnetic. It is insoluble in water. The dose is from 5 to 20 grains.

Iron Albuminate.—Ferric albuminate, *ferri albuminas*, has been considerably used of late on account of its supposed easier absorption than other preparations of iron. It occurs ordinarily in a brown powder of saline taste. It is soluble in water. The dose is from 20 to 30 grains in solution, which must be fresh. It may be given in pill. It is mild in action and a suitable chalybeate for *chlorosis*. A solution of ferric albuminate is official as *liquor ferri albuminati* (Ger. Ph.).

Iron Bromide.—Bromide of iron, ferrous bromide, is a yellow salt of a styptic taste. It is deliquescent and very soluble. It is given in solution, and its decomposition is prevented by the addition of sugar. A proposed preparation contains 200 grains of bromine, 85 grains of iron filings, 4½ oz. of distilled water, and 3 oz. of sugar. The dose of this solution is 20 drops, gradually increased. It is supposed to be *alterative* as well as *tonic*, and has been recommended for *scrofula* and *chorea*.

Iron Oxalate.—Oxalate of iron, *ferri oxalas* (U. S. Ph., 1880), occurs as a yellow, crystalline powder, odourless and tasteless, of little solubility in water. The dose is from 2 to 3 grains. It is a feeble chalybeate.

Iron Succinate.—Ferric succinate, succinate of iron, *ferri succinas*, is a yellow salt which has been used in *anæmia*, and also for the relief of *jaundice*. The dose is 5 grains. It is little employed.

Iron Tannate.—Tannate of iron, *ferri tannas*, as ordinarily prepared, occurs in flat pieces of a crimson colour without taste. It is insoluble in water. The dose in pill is from 2 to 5 grains. It is used as a *tonic* and *astringent*. Ink is another tannate of iron or, more properly, an aqueous solution of ferric gallotannate. It is used in domestic medicine as an application to *ringworm*.

Iron Malate.—Malate of iron, ferrated extract of apple, *extractum ferri pomatum* (Ger. Ph.), is a combination of the juice of sour apples and powdered iron. It is much esteemed in Germany, and is given in tincture, *tinctura ferri pomata* (Ger. Ph.). The dose of this is from 15 to 30 minims.

Aside from those I have mentioned, there is a considerable number of iron preparations which are neither official nor very useful. The number is receiving additions almost daily, and it must be confessed that there are some few ferruginous products now being tried which seem to promise well and which perhaps may prove more desirable than some of those which are officially recognised. At present, however, the official list is one of sufficiently generous proportions, and from it the most critical should be able to choose a satisfactory preparation.

As to the hypodermic use of iron, little need be said, for it is a practice which is hardly ever demanded and one to which all objections to continued subcutaneous injections apply most strongly. If one must so administer iron, the ammonio-citrate is perhaps as suitable a preparation for the purpose as any. According to M. Dori (*Brit. Med. Jour.*, vol. ii, 1893, *Suppl.*, p. 72), the daily dose should be about 5 centigrammes, dissolved in 1 gramme of water and injected into the interscapular area.

Henry A. Griffin.

IRRIGATION may be defined as (1) the act of moistening with water or other liquid, and (2) the act of bathing or cleansing by means of a liquid stream.

Irrigation is employed in many branches of medicine and in various ways. Its more usual objects are the following : 1. To cleanse mechanically. 2. To cleanse chemically by the use of an antiseptic liquid. 3. To change the temperature of a part or of the entire organism.

Irrigation may be constant or occasional. Constant irrigation is usually employed for its mechanical, thermal, or refrigerant effects, and by preference should be accomplished with a non-irritating, non-poisonous fluid—for example, a solution of sodium chloride, 6 to 1,000.

A sufficient quantity of even a weak poisonous solution will in time be absorbed and cause trouble. Occasional irrigation may be performed with stronger or weaker chemical solutions, according to the part affected. The mouth, for example, will tolerate a much more irritant solution than the peritonæum will.

Methods of irrigating the Various Regions of the Body.

(For the solutions to be used, see Antiseptics, etc.)

The Eye.—The conjunctival sac is best washed by means of a glass vessel called an undine. It is of the size and shape of a medium-sized pear standing on its larger end and with the smaller open end turned to one side. In the side opposite this opening is a larger aperture for filling or rapidly emptying the vessel. From the smaller hole a fine and very even stream may be poured, the force of which is regulated by the height at which the undine is held. In irrigating the eye during an operation on the globe great care must be taken to hold the lid with a speculum or retractor, so that no undue pressure on the globe by the lid or instrument shall be possible. Always warn the patient that you are about to wash the eye, so that he may be prepared for the shock. It is possible to wash out the anterior chamber through a wound by means of a fine syringe or medicine dropper. The lacrymal sac and duct may be washed out when necessary by slitting the canaliculi and then using a piston syringe with a German silver cannula. The cannula may be inserted into the bony canal, and the irrigation fluid comes out of the nose. This irrigation is best performed with the patient in the sitting posture, so that the fluid shall not run into the throat.

The Ear.—The auditory canal and, when the drum head is perforated, the middle ear may be well irrigated either with a piston

syringe made for the purpose or with a fountain syringe or glass irrigator. The latter consists of a glass vessel with a long rubber outflow tube and a suitable nozzle. This fountain syringe or irrigator is the best instrument to leave in the hands of the nurse, because the force of the fluid may be regulated by hanging the vessel a known distance above the patient's head. Injury to the parts by overzealous effort is thus avoided. Where more force is necessary the physician may use the piston syringe. The upper posterior part of the auricle is grasped and drawn gently upward and backward to straighten the canal, and the irrigation may be performed without inserting the nozzle into the meatus. Irrigation of the ear is for mechanical, chemical, or thermic effect. For the latter purpose the solution may be of the temperature of 108° F., and the irrigation may be long and frequent. When the mastoid cells are diseased and have been opened surgically, it is often possible to wash from the wound into the ear and *vice versa*.

The Nose.—The nasal cavities may be irrigated from the anterior or posterior nares. Several good irrigating cups with spouts have been devised, or a tumbler of warm solution and a teaspoon will be found to answer the purpose. The patient should recline or sit with his head thrown well back. The operator should then slightly elevate the tip of the nose with his left hand, and the patient is to be instructed to breathe through his mouth. The solution is to be poured first into one nostril, then into the other, and when the nasal cavity is seen to be full the patient is to throw his head forward over a basin. When the irrigation is finished he may blow his nose, but without violence.

The nose is best cleaned by means of the post-nasal syringe, the bent nozzle of which is put into the pharynx pointing forward. The current is thus always in one direction, and that outward. The frontal sinuses, when the seat of chronic suppuration, may be irrigated for the mechanical and chemical antiseptic effect. It is first necessary to open the sinus at its inner angle with chisel or trephine. Good drainage may usually thus be established through the infundibulum into the nose. The irrigation may be performed with a gravity or a piston syringe.

The antrum of Highmore is sometimes the seat of empyema and may be easily entered by punching an opening into this cavity through the tooth socket after extracting the second molar. Frequent irrigation through this opening will be likely to cure the disease, and when this has been accomplished the opening may be closed by a plastic operation.

The Mouth.—It is not usually necessary to resort to irrigation in cleansing the buccal cavity, but after certain operations, such as the removal of the whole or a part of the tongue, irrigation with a gravity (fountain) syringe is of considerable value. This is best done with the patient in the sitting posture, so that little of the fluid shall be swallowed. Much of the good accomplished depends on the frequency of the washing.

The Stomach is well cleansed by irrigation commonly called *lavage.* The apparatus consists of a rubber stomach-tube, which should be as smooth as possible with one or two sunken or "*velvet-eye*" openings, a funnel fitted to the end of the tube, and a vessel for pouring in the irrigating fluid. The stomach-tube must be more than twice as long as the distance from the front teeth to the stomach. In performing lavage it is well to cool the tube with water, then insert the wet tube into the patient's mouth. He is now requested to swallow the instrument without biting it or hindering it with his teeth. As soon as deglutition has begun, the operator may quickly push the tube onward into the stomach. It is never necessary to oil the tube. In the insertion of the stomach-tube the patient may sit and the physician may stand in front of him or behind his chair. The tube being in place, the fluid is to be poured in through the funnel, and the force of the current regulated by the height at which the funnel is held. When enough fluid is thought to have entered the stomach, the funnel and outside portion of the tube may be lowered as far as permitted by the length of the rubber, care being taken that the entire tubing and a little of the funnel contain liquid. The apparatus now becomes a siphon, and the stomach is rapidly emptied. This procedure may be repeated as often as needful or convenient at one sitting. (Cf. LAVAGE.)

The Rectum and Colon.—Irrigation is an excellent procedure in most of the inflammatory diseases of the lower part of the alimentary tract. It is a means of relief too often overlooked by physicians. It is of especial efficacy in the *septic colitis* and *diarrhœa of children.* The irrigation consists practically of a succession of enemata. A large fountain syringe ought to be used, and four to eight quarts of liquid for an adult, one to two quarts for a young child. In certain cases, especially in adults, a long rectal tube, well oiled, may be inserted carefully its full length and the fluid injected through it. If stricture of the gut exists, the tube should not be removed after each filling, but the fluid may be allowed to run out through the opening by which it entered until the washing is thought to have fulfilled its purpose. Antiseptics, styptics, etc., may also thus be applied to a very large surface. The irrigation is best performed with the patient lying down with the buttocks raised. He may lie either on his left side, on his back, or on his abdomen. Little children may lie on the bed or on the nurse's lap. They may be on their backs or bellies, whichever position seems to give them most comfort, but the hips should be slightly elevated. It is safer here not to use a rectal tube, but the ordinary rectal syringe nozzle of the same size used by adults. This must be well oiled and should be passed carefully under the guidance of the eye. A rubber sheet should be so arranged that the operator shall not be splashed, and so that the waste shall run into a vessel placed for the purpose. Now, on letting the water run, the child's colon fills and then empties itself through the anus alongside the tube,

which must be held carefully in position until the entire quantity of fluid has been used. The effect of such an irrigation with warm water without soap or other irritant is often almost marvellous.

The Vagina is best irrigated by means of a gravity syringe with a nozzle of glass or hard rubber having several apertures, so that streams emerge on all sides. The patient should lie on a pan which permits the hips to be at a higher level than the shoulders. The abdominal contents thus fall away from the pelvis and the vagina is thoroughly filled and "ballooned" out by the fluid. Irrigation of the vagina is for one or more of the three main purposes mentioned above—*i. e.*, to cleanse mechanically, to cleanse chemically, or to act thermically upon the pelvic organs. For ridding the vaginal canal mechanically of pus, mucus, or other objectionable substance, the irrigating stream should be swift and quite powerful. The syringe may be hung high, and a nozzle with large openings should be used. For the thermic or antiseptic effect, a slower, less powerful current is proper. By far the commonest employment of vaginal irrigation is for the application of heat to the pelvic organs. Here the flow may be slow, but the douche must last a long time—at least ten minutes and preferably fifteen or twenty. A gallon or more of fluid at from 108° to 120° F. should be used, and the treatment may be repeated as often as the case seems to require it. From two to eight douches a day will meet ordinary needs.

The Uterine Cavity is irrigated safely only when the water runs out as fast as it runs in. Various instruments have been devised to accomplish this object, most of them consisting of two connecting tubes, one within the other or one beside the other. Two woven catheters —new ones—may be used for this purpose, or even a single well-fenestrated rubber drainage-tube bent in the middle and pushed into the uterus with both ends projecting from the os. If the uterus is well dilated or flabby, a single tube may be used, but only through a speculum, so that the operator may be assured by sight that the return flow is unimpeded. The uterine douche is used to remove clots, shreds, pus, etc., from the cavity. It is also used very hot (at 120° F.) to check bleeding.

The Urethra and Bladder.—The washing out of these organs in women does not differ except in detail from the treatment of the urethra and bladder in men. Irrigation of these parts is usually performed for mechanical and chemical antisepsis. It may be frequent in dealing with the anterior urethra in the male, but when the posterior parts are involved irrigation should rarely be done oftener than once a day. The graduated gravity glass syringe or the piston syringe with a woven catheter may be employed, and everything should be strictly aseptic. When watery fluids are to be used, it is best to use sterile glycerin as a lubricant. Fats often coat the mucous membrane and prevent contact with the irrigating fluid. The catheter should be several sizes smaller in calibre than the narrowest part of the urethra, so that the liquid may easily run out alongside. Having properly lubricated the catheter, introduce it into the anterior urethra and affix the syringe. The fluid runs out in a good stream by the side of the catheter, which may now be slowly pushed toward the bladder. As soon as the eye of the instrument enters the posterior urethra the catheter is quite firmly embraced by the compressor urethræ muscle, and no more fluid flows out at the meatus; instead, it flows into the bladder, washing on its way the whole membranous and prostatic canal. It is now necessary to know the quantity of fluid which is running into the bladder, so that this viscus may not be too much distended. If the patient is not anæsthetized his sensations will usually be a sufficient guide. The catheter, while in place, should be detached from the syringe, and it will be noted that no fluid escapes. Now, on pushing the instrument still farther, it enters the bladder, and the injected fluid will run out through the catheter. If it is desired to irrigate the bladder, but not the deep urethra, the catheter may at once be made to enter the vesical cavity. When we desire to wash away the tough mucus which often adheres to the bladder wall, especially near the internal urethral opening, it is best to use a strong piston syringe and inject forcibly, taking care to change the position of the eye of the catheter by revolving the instrument between the thumb and finger.

Wound irrigation is employed for mechanical cleansing, for chemical antisepsis, and occasionally for thermic effect. The gravity irrigator is the usual form used. Where there is much hæmorrhage and the field of operation is obscured by clots the irrigator stream may take the place of the sponge. Where pus is evacuated the irrigator washes it rapidly from the wound. When a large abscess can not be incised in such a way as to reach the point of infection—for example, a spinal abscess—the irrigator stream through a long tube inserted into the cavity will clean out pus, cheesy material, and bony and other detritus. A hollow sharp spoon with an opening in the bowl has been invented, so that the irrigator hose may be fastened to the handle and irrigation and curetting in a cavity may be simultaneously performed. After the suture of wounds which should heal by first intention, it is wise to wash them out by inserting the irrigator nozzle at one end and holding apart the lips of the wound at the other end, so that no clots may be left in the cavity.

If a wound is healing without suppuration, irrigation not only is a superfluity, but is often harmful, for it breaks down physiological adhesions. If suppuration exists, however, irrigation becomes a most valuable aid in the treatment. The various apertures should in turn become the points of entrance for the fluid, so that every part of the wound, no matter how complicated its shape, may be thoroughly washed by the stream. When such wounds are very septic, or when the cavity is very large or intricate and the discharge copious, the best treatment is constant irrigation

with a bland solution. No antiseptic should here be used. The part should be exposed, no dressing applied, and the fluid from a gravity irrigator should be made to run into the wound, now at one opening, now at another, constantly. The rubber hose may be slightly compressed with a cord or safety pin, so that the stream shall not run too quickly, and the outflow from the wound should be caught in a rubber cloth and led away to a vessel at the side of the bed. The writers have seen a case of suppurating knee joint where 20,000 gallons of salt solution ran through the joint in five weeks. The patient recovered without amputation.

The rules for irrigation in wounds involving the free peritonæum differ somewhat from the general modes of procedure. It is not possible safely to employ antiseptic chemical solutions in washing out the abdomen. Warm water or warm saline solution is used with good results. If in operating in the abdominal cavity a collection of septic matter is prematurely or accidentally opened, be this an abscess or one of the hollow viscera, it is necessary to use every precaution to limit the extent of peritoneal surface which may by contact be infected. If possible, the opening through which the contaminating substance escapes must be plugged and all suspicious material rapidly wiped away from neighbouring organs. Strips of gauze (iodoformized by preference) may now be packed between the viscera in such a way as to dam off the uninfected peritonæum. This accomplished, if there is little of the noxious matter it may be allowed to escape and must be removed at once by sponging. If the collection is large—for example, a good-sized abscess—the cavity may be washed out by the irrigator stream. It is obvious that washing the general peritoneal cavity under such circumstances must spread the infection, not limit it. When non-septic matter has escaped in large quantities among the abdominal organs, it is often wise to wash out the whole abdomen with a large and powerful stream. This is the case in ruptured ectopic gestation sacs where there are many clots, not in themselves septic, but an excellent soil for the development of microbes. Several large pitcherfuls of warm water may be poured in succession through the wound, with the result of washing away most of the objectionable material and without the danger of spreading infection.

Antiseptic irrigation of joints is a procedure which may be productive of great and immediate good, but when the antisepsis exists only in the mind of the operator it may be far more dangerous than the disease which it is intended to cure. For the necessary antiseptic detail in preparations the reader is referred to the article on *Antiseptics in Surgery*. A sterile, rather small trocar and cannula and a glass irrigator with a long tube are the necessary instruments. The liquid may be a warm solution of carbolic acid, from two to five per cent. The trocar and cannula are inserted into the most fluctuant part of the joint, and the contents of the sac are allowed to escape. When the stream ceases and the fluid comes drop by drop, the rubber tube with the irrigating fluid running is affixed to the cannula, and soon the joint cavity is filled with the solution. It is now allowed to escape, and if coagula prevent the free outflow a piston syringe may be used for suction only. This filling and emptying of the joint should be repeated until the surgeon is satisfied that all possible good has been done. In some joints, notably the knee, two cannulæ may be inserted, one at each side. The irrigation may then be accomplished by a continuous stream.

When the operation is finished, be sure that no toxic quantity of the solution remains in the joint. Carbolic-acid poisoning and iodoform poisoning from this cause have been encountered.

Arpad G. Gerster.
Howard Lilienthal.

IRRITANTS. — Preparations having an irritant effect simply upon the tissues are rarely used for that purpose alone, and are properly classed under counter-irritants, to the article on which the reader is referred. Occasionally it is desired to prevent the healing of blisters and sores made by cauterization, and for these purposes mezereum is probably as useful as anything. It may be employed in the form of the official fluid extract or in that of an unofficial ointment. It may also be used when the irritation of issues or setons is to be maintained. Solutions of copper sulphate or the salt itself may also be used under the same conditions, but are excessively harsh and rarely to be advised save in veterinary practice. In *phlyctænular conjunctivitis* and in cases of *corneal opacities*, when the keratitis causing them has subsided, the dusting into the eye of small quantities of calomel free from foreign matter has an effect which can hardly be regarded as anything but irritant. It is usually followed by the cure of the conjunctivitis, and in the case of the corneal opacities by a more or less complete disappearance of them. In this latter condition it may be necessary to prolong the treatment for some weeks, the dusting being performed every two or three days. Ordinarily the irritation is but slight and lasts but a short time. A number of emetics and cathartics owe their action to their irritant effects upon the stomach and intestines, but their uses have been discussed under their respective headings.

Russell H. Nevins.

ISINGLASS, *ichthyocolla* (U. S. Ph.), is used in the preparation of court plaster, *emplastrum ichthyocollæ* (U. S. Ph.).

ISONAPHTHOL.—See Naphthol.

IZAL.—This is an oily liquid, a hydrocarbon, obtained by roasting bituminous coal, employed as a *disinfectant* and *germicide*. Its odour is not disagreeable. It forms an emulsion with water which does not injure the skin or surgical instruments. Professor Sheridan Delépine, of Victoria University (*Med. Chron.*, Sept., 1895), says that among its most remarkable features are its comparative insolubility and non-volatility at the ordinary temperature, properties which, he adds, it seems difficult to associate with an active disinfectant, but which numerous experiments have proved not

to be incompatible in this case. Izal, he says, may be freely administered internally, used over extensive wounds, or injected under the skin without bad effects.

As it was the author's intention to study carefully the effects which certain disturbing factors might have on the results obtained, he investigated the action of izal on a small number of germs. He selected them so as to get types of the most important forms of pathogenic bacteria which one might have to deal with in practice. These organisms were the *Bacillus tuberculosis* (*hominis*), the *Bacillus coli communis*, the *Staphylococcus pyogenes aureus*, and the *Bacillus anthracis* (in the sporing stage). In the course of seven months he conducted over a hundred experiments with these four microbes, paying special attention to the conditions of growth, temperature, dryness, age of the germs, etc., which might be expected under ordinary circumstances to influence the resistance of bacteria or the activity of any disinfectant.

Sputum obtained from a case of advanced *phthisis* and found teeming with tubercle bacilli was allowed to dry on paper for seven days, being kept during that time in a closed capsule in the dark at the temperature of the laboratory (from 59° to 68° F.). Pieces of paper so prepared were then severally steeped in izal—in izal 1 part of which had been diluted with 5 parts of water, and in izal diluted with 10 parts of water. In each case the infected paper was allowed to remain in the disinfecting fluid for forty-five minutes, after which it was removed and inserted under the skin of a guinea-pig. In a check experiment, paper smeared with the same quantity of the same sputum, and prepared at the same time and in exactly the same way as the other pieces of paper, was also inserted under the skin of a guinea-pig of the same age and size as the other guinea-pigs. In all the cases in which the sputum had been treated with izal, in fifty-four days after inoculation no evidence of tuberculosis was found post mortem, even at the seat of inoculation, while in the check animal tuberculosis was already well marked on the twenty-seventh day, and very advanced on the fifty-fourth. Similar results were obtained with paper smeared with scrapings of a tuberculous gland obtained from a case of recent general tuberculosis, the tubercular matter being allowed to dry as in the previous case. Fresh tuberculous matter from a cheesy lymphatic gland (tuberculosis of fifty-six days' duration) was made into a thick emulsion with sterilized water. This was mixed with izal 1 part of which had been diluted with 10 parts of water, and after two minutes the excess of izal was removed with sterilized filter paper. The thick pulp left was allowed to dry for twelve hours, and then a guinea-pig was inoculated subcutaneously with it. A check guinea-pig was inoculated with exactly the same quantity of a part of the original emulsion of cheesy gland which had not been treated with izal. After fifty-four days the first animal showed no trace of tuberculosis at the post-mortem examination. The check animal was already in an advanced state of tuberculosis at the end of three weeks, and the disease was found, post mortem, to be extensive fifty-nine days after inoculation.

Professor Delépine deduces from these experiments that izal mixed with 10 parts of water will disinfect in forty-five minutes dried tuberculous sputum or other tuberculous matter, and that fresh tuberculous products of great virulence, when mixed with about an equal quantity of izal of the same strength and allowed to dry at the ordinary temperature for twelve hours, are also completely disinfected. He is unable to state how much shorter time or greater dilution the disinfectant will admit of.

In interpreting the results, he says, it is necessary to remember that the *Bacillus tuberculosis*, though not known to be a sporing organism, is one which is not easy to kill under ordinary circumstances. This is due to the bacillus being usually embedded in thick mucus or in cheesy products which effectually offer a barrier to some of the best chemical disinfectants (owing to their being usually at the same time capable of causing coagulation of albuminous compounds). The great resistance which the bacillus presents to the effects of drying is another reason why it is so difficult to kill, for, as desiccation is not fatal to it, the germ may remain active in the midst of masses too dense to be penetrated by disinfecting solutions of poor penetrating power or incapable of acting for a considerable length of time.

The specimens of the *Bacillus coli communis* used in Professor Delépine's experiments had been obtained from fatal cases of Asiatic cholera. Before being used, the microbes had been cultivated for nine days on potato, and the growth then scraped off and mixed with sterilized alkaline broth. With the emulsion so obtained silk threads were impregnated. These threads were allowed to dry for six hours in a sterilized capsule in the dark, the temperature being from 59° to 68° F. After this they were placed severally in izal diluted with 5, 10, 50, 100, and 200 parts of water, and allowed to remain in the mixtures for a minute in the case of the stronger solutions, and for ten minutes in that of the weaker ones. After this they were transferred to tubes containing alkaline bouillon, some being previously washed in sterilized water, others not. Check threads that had not been exposed to the action of the izal, but had been kept in sterilized water for the same length of time as the other threads had been, were also cultivated in alkaline bouillon. After twenty-four hours at 36° C. the check tubes showed a typical growth of the bacillus, but there was no growth in any of the tubes containing threads which had been dipped in izal. These tubes were watched for twenty days, and during the whole of that time no trace of growth could be discovered. This absence of growth was tested not only by microscopical examination, but also by plate cultivations in nutrient gelatin and agar. It is therefore evident, says Professor Delépine, that izal diluted with 200 parts of water is a

safe germicide for micro-organisms as resistant as the *Bacillus coli communis* or less resistant.

The *Staphylococcus pyogenes aureus*, one of the commonest causes of suppuration, was considered a fair specimen to use for testing the value of izal in the treatment of ordinary *wounds*. Fresh cultivations on agar were made, and after being kept for forty-eight hours in the incubator at 96·8° F., the tubes were left for twenty-four hours more at the temperature of the laboratory. The growth was then scraped off and spread thickly on small pieces of sterilized filter paper. The paper so infected was allowed to dry slowly at the ordinary temperature in a sterilized capsule, kept in the dark for three hours. These pieces of paper were then steeped in izal diluted either with 100 or with 200 parts of water, and left in the mixture for two hours, an hour, or ten minutes. After these various exposures the pieces of paper were removed, washed carefully in sterilized water, and dropped into tubes containing alkaline bouillon. In a check experiment the paper was left in sterilized water for the same length of time as the other papers had been left in izal, and then transferred to alkaline bouillon. From none of the papers treated with izal diluted with 100 parts of water could any growth be obtained. The same was true when izal was diluted with 200 parts of water, except when the exposure was not more than ten minutes in duration. The bouillon inoculated remained clear for three days (during which it was kept at a temperature of 86 F.°), and at the end of that time it was impossible to obtain any evidence of growth by plate cultivations in nutrient gelatin. A sufficiently large quantity of the bouillon was used in each case to prevent any chance of error. In the check experiments a well-marked growth was obtained at the end of twenty-four hours, and at the end of thirty-six hours the bouillon was very turbid. Plate cultivations made with this culture proved that nothing but the *Staphylococcus pyogenes aureus* had grown in the bouillon. From this Professor Delépine thinks it evident that izal diluted with 100 parts of water is a reliable antiseptic for the dressing of surgical wounds made with the usual antiseptic or aseptic precautions.

In making experiments with the *Bacillus anthracis* it was not thought necessary to study the action of izal on the non-sporing organism. Spores of great virulence were used. These spores were prepared in the same way as those which had been used in previous experiments and been found to resist ordinary disinfectants in usual dilutions, with the exception of the most powerful chemical agents. Judging by the results obtained with carbolic acid, Professor Delépine did not expect that izal would be capable of killing these spores in a reasonable time, and the results justified his expectations. The most interesting results obtained were those proving the remarkable inhibitory power which even diluted izal had on the growth of the anthrax spores. Thus, in alkaline bouillon to which the one hundredth part of izal had been added it was impossible to get the spores to show any sign of growth, even when kept at a temperature of 96·8° F. for seven days, no precaution being taken to prevent the volatilization of the izal. The spores, however, were not killed, for after thorough washing in sterilized water and cultivation in fresh bouillon an abundant growth was obtained.

Professor Delépine sums up by saying that izal diluted with 100 or even 200 parts of water is a powerful and reliable antiseptic when contact for a sufficient length of time is secured. It is, he says, more powerful than carbolic acid, causes very little irritation of living tissues, is not poisonous when used in moderate doses, and, practically, is not volatile, so that it must be held to possess great advantages over carbolic acid.

JABORANDI (Br. Ph.), *pilocarpus* (U. S. Ph.), *folia jaborandi* (Ger. Ph.), is the dried leaflets of certain plants of the genus *Pilocarpus*, the Br. Ph. and the Ger. Ph. recognising *Pilocarpus pennatifolius*, and the U. S. Ph. recognising *Pilocarpus selloanus* (Rio Janeiro jaborandi) and *Pilocarpus jaborandi* (Pernambuco jaborandi). The leaflets have an aromatic odour when bruised; and when chewed, an aromatic, bitter taste which later becomes pungent and is accompanied by an increased flow of saliva. The active principle of the leaves is an alkaloid called *pilocarpine*, but they also contain another alkaloid, *jaborine*, as well as *jaboric acid*, volatile oil, and tannin. Chemically, the similarity between pilocarpine and jaborine is pronounced, the formula of pilocarpine being $C_{11}H_{16}N_2O_2$, while that of jaborine is in all probability its molecular double, $C_{22}H_{32}N_4O_4$, and jaborine may be produced by heating pilocarpine under suitable conditions. The physiological actions of the two alkaloids are, however, widely different, for in this respect jaborine bears a striking resemblance to atropine, while pilocarpine has an opposite and even antidotal relation to that drug. It is for this reason, no doubt, and because of the variation in alkaloidal powers which different specimens of jaborandi present, that observations of its action have been so contradictory, and it must therefore become evident that if it is the action of pilocarpine which is desired it is that alkaloid which should be used, and a preparation of it uncontaminated with jaborine, rather than jaborandi itself.

The most pronounced actions of jaborandi are those of a *diaphoretic* and *sialagogue*. When a full dose of the remedy (1 drachm) is given in infusion there results, usually within fifteen minutes, a pronounced hyperæmia of the head and neck, and this is soon followed by sweating, which at first is confined to the head, but afterward becomes general. This sweating is copious and lasts usually for three or four hours. Salivation accompanies the sweating, and in fact is the more constant phenomenon of the two. The amount of saliva secreted is very large, and the increase continues for about the

same length of time as the perspiration does. The bronchial secretion, too, is often much increased—so much, in fact, that very serious symptoms have occurred from the sudden development of pulmonary œdema after the administration of pilocarpine. Increase of the nasal and lacrymal secretion is sometimes observed, and occasionally there is diarrhœa. The drug in some cases produces nausea and vomiting, and, since the experiments upon animals show that jaborandi increases both the gastric and the intestinal movements, it is possible that the vomiting and diarrhœa which occur at times in man may be similarly explained, though increase of intestinal secretion also is probable. During the sweating the rapidity of the pulse is considerably increased, but the arterial tension is somewhat lowered. The respiration is not infrequently accelerated. The bodily heat has been said to rise somewhat at first, but this is to be doubted. It is certain, however, that with the sweating there occurs a considerable fall of temperature. The pupils are often contracted, and disturbed vision may result. It is a singular fact that the action of jaborandi is much less pronounced in children than in adults. Following the active phenomena produced by pilocarpus there comes a stage of relaxation and even of exhaustion. The skin is pale, chilliness may be complained of, and drowsiness, dulness, and languor appear and last for some hours.

No certain explanation at present exists of the mode in which pilocarpus acts to cause salivation and sweating, but the general belief is that these phenomena are due to a stimulation of the peripheral endings of the glandular nerves. Some discussion has occurred as to the reaction of the sweat poured out under the influence of pilocarpine; it has been said that the secretion was first acid, then neutral, and finally alkaline, while others have believed it to be alkaline throughout. However this may be, the fact is undoubted that the amount of urea eliminated in the sweat is enormously increased, the average quantity having been placed at 17 grains. The action of large doses of jaborandi upon urinary secretion is open to some question, but there seems no convincing evidence that the amount of urine is increased or its urea percentage raised. If small doses are given, however, and frequently repeated, it seems evident that diuresis does take place. It has been alleged for pilocarpus that it has oxytocic powers, but, though it seems to increase the strength of uterine contractions when once they have been initiated, the abortifacient potency of the drug is inconsiderable. Applied locally to the eye, pilocarpine, according to Tweedy, causes contraction of the pupil, increased tension of the structures concerned in accommodation, and approximation of the nearest and farthest points of distinct vision, with retinal impairment and consequent disturbance of vision. It has been observed that occasionally the growth of hair is increased by the internal use of pilocarpine, and coarseness of the hair and a change of its colour from light to dark have also been attributed to its employment.

The therapeutics of jaborandi is strictly in keeping with its physiological action, for it is as a diaphoretic that it is mainly employed. To promote sweating it is the most powerful remedy we possess, but this very power makes it a remedy to be used only with the greatest care, for it is exhausting in its action, and therefore in adynamic patients may be productive of great danger. Aside from its contra-indication in asthenia, jaborandi must never be employed in pronounced cardiac embarrassment from organic disease, in pulmonary congestion or œdema, either threatening or existing, or in irritation and inflammation of the alimentary tract. *Uræmia* is the condition in which jaborandi shows its most brilliant results, and the copious elimination, not only of fluid but of urea, which takes place from the skin under its influence is productive of great benefit. In various forms of *nephritis* the frequent use of small doses is recommended, to the end that sweating, save of the slightest, shall be avoided, but that diuresis shall occur. In *dropsy* the remedy is also serviceable, and especially in *renal dropsy*, for, though cardiac dropsy may, and indeed often is, benefited by its use, there is more apt to exist in such a case one of the contra-indications already alluded to. Not only are dropsical effusions like *hydrothorax* and *ascites* thus removed, but inflammatory exudations as well, and *pleurisy with effusion* in its subacute stage may well be treated with pilocarpus. That bronchial exudation may be removed in the same way is no doubt true, and *bronchitis* and the *humid form of asthma* have been benefited by this means. *Pulmonary œdema* even has been relieved thus, but the use of pilocarpine in this condition is hazardous in the extreme, for, as has already been said, it is quite competent not only to aggravate this œdema, but even to cause it when previously it has not been present. In pulmonary œdema resulting from the use of pilocarpine, it should be stated, atropine given by hypodermic injection has apparently been the cause of saving life. In pulmonary diseases, therefore, pilocarpus should be withheld or used with much caution. The drug may be used with benefit in the early hours of *acute congestive conditions* which follow exposure to cold. *Coryza*, *bronchitis*, *muscular* or *articular rheumatism*, and similar conditions are treated thus at times, but it does not appear evident that the remedy has any advantage over the simple "sweat" as ordinarily produced, and its violence is as unnecessary as it occasionally is perilous. *Diabetes insipidus* has been thought benefited by its use, and, like many another drug, it has been recommended for *glycosuria*. That it possesses any real curative power against glycosuria is not to be believed. Jaborandi has been used as a *galactogogue*, but it is hard to see how any increase of milk could result from its employment, because its usual action is rather to cause diminution than increase of that secretion. In *mumps* pilocarpine has been said to cause relief and even prompt cure when given early in the disease. *Diphtheria* has been treated by the use of pilocarpine, and many

are enthusiastic in its praise, maintaining that by it the membrane is softened and detached. On the other hand, by some the practice is strongly condemned. It seems reasonable to believe that, used cautiously, it may be of benefit in sthenic cases, but circulatory or systemic enfeeblement must absolutely contra-indicate it. In *skin diseases associated with scaling* or accompanied by much dryness of the epidermis the use of jaborandi in small doses is at times beneficial, since by it the cutaneous moisture is increased. In *alopecia* the drug may be applied locally and given by the mouth or by subcutaneous injection. The efficiency of its local application is doubtful, but its internal use seems at times to aid in the cure, though the practice can not be credited with brilliancy or constancy. Considerable doses of pilocarpine have been credited with aborting *erysipelas*, and some have thought the remedy of value in *prurigo* and *urticaria*. The application of jaborandi to the throat in inflammatory conditions of the parts when associated with dryness is thought desirable by some, and Dr. J. Solis-Cohen is said to employ a spray containing from 1 to 5 minims of the fluid extract of pilocarpus to 1 oz. of water in *laryngitis with scanty secretion*. In ophthalmology the alkaloid pilocarpine is considerably employed, being preferred by some to eserine.

The remarkable physiological antagonism which exists between atropine and pilocarpine suggests their antidotal usefulness in common. That atropine will cut short the supersecretion caused by jaborandi is undoubtedly true, and its employment has unquestionably saved life, but pilocarpine seems less potent to counteract the symptoms of *poisoning with atropine*. Nevertheless, it is not without action in such cases and may be employed, not, however, as pilocarpus, but as the alkaloid pilocarpine, because of the greater certainty of its action.

It can hardly be said that jaborandi is a popular remedy, and its use, though apparently growing more common, is not as yet an extended one. This is due to the potency of its action and to a reputation it has obtained for treachery, which, however, is probably more justly to be attributed to the preparation than to the drug itself. However that may be, there prevails a dread of the vigorous qualities of jaborandi, and it can not be denied that the sentiment is a wholesome one.

The dose of the powdered leaves is from 5 to 60 grains. They are not frequently administered internally, however, though occasionally added to poultices to provoke local perspiration, the amount used being about ½ oz. Of this practice Dr. H. C. Wood says that from it there may result excessive and very prolonged general sweating. The preparation of jaborandi oftenest employed is the fluid extract, *extractum pilocarpi fluidum* (U. S. Ph.). Of this the dose is from 15 to 30 minims. There is also used a solid extract, *extractum jaborandi* (Br. Ph.). The dose is from 2 to 10 gr. Infusion of jaborandi, *infusum jaborandi* (Br. Ph.), is made with 1 part of jaborandi and 20 fl. parts of boiling distilled water. It is objectionable because of the size of its dose, which is from 1 to 2 fl. oz. A tincture, too, is official as *tinctura jaborandi* (Br. Ph.). Of this the dose is from ½ to 1 fl. drachm.

Of the alkaloid pilocarpine two salts are official, the hydrochloride and the nitrate. (See PILOCARPINE.)—HENRY A. GRIFFIN.

JALAP, *jalapa* (U. S. Ph., Br. Ph.), *tubera jalapæ* (Ger. Ph.), is the dried tuberous root of *Ipomœa Jalapa* (*Exogonium Purga*, or *Ipomœa Purga*), a plant native to Mexico. The root has a peculiar smoky odour and a sweetish, acrid, and nauseous taste. As seen in pharmacy, jalap is usually in powder, of which the colour is yellowish-gray. The active principle of jalap resides in a double resin divisible into two portions, one which is hard and insoluble in ether, the other soft and soluble in that fluid. Both are active purges, but the hard resin is the more potent of the two and has been called *rhodeorrhetin*, *convolvulin*, and *jalapin*.

Jalap is locally an irritant, the inhalation of its powder causing sneezing and coughing. When swallowed, it is irritant also, and often causes nausea. The principal action of jalap is to produce *catharsis*. The purgation is generally accompanied by tormina, and in overdoses jalap causes violent gastro-enteric irritation. Although the drug has been said to be absorbed by the skin of animals, and to cause purgation when thus taken in, it is evident that no such action takes place in man, the remedy being one whose action is purely local. The catharsis of jalap is usually produced in from two to four hours. It is thorough and energetic, and the evacuations, which at first are semifluid, are subsequently watery. The intestinal secretions are increased by the action of jalap, and the bile as well.

The therapeutics of jalap is the production of thorough purgation with large watery evacuations. The remedy may be given alone, but is far more commonly used in combination with others, compound jalap powder being the preparation most frequently employed. This combination is particularly to be recommended in *dropsical affections*, because of the watery purgation it causes; and there is reason to believe that it possesses *diuretic* power as well. Combinations of jalap and calomel are much employed, and the energy which resides in a powder containing from 5 to 10 grains each of calomel and compound jalap powder may easily be understood. The official representative of this combination of calomel and jalap is the compound cathartic pill. The resin of jalap is to be preferred to the whole drug because of its activity. The remedy is one which may well be employed in the early days of *febrile* and *inflammatory diseases*, and is particularly esteemed in *malarial infections*, as well as in disturbances of a "bilious" nature, because of its power to remove *portal congestion*, a power which it manifests, especially when combined with calomel. Further than these, the remedy has no positive indications, but it is contra-indicated by gastric and intestinal inflammations in general. Its griping propensities may be reduced by combining it with an aromatic or an antispasmodic, such as hyoscyamus.

The dose of powdered jalap is from 15 to 30 grains. The alcoholic extract of jalap, *extractum jalapæ* (U. S. Ph.), is given in doses of from 10 to 20 grains. The dose of the British extract, *extractum jalapæ* (Br. Ph.), is from 5 to 15 grains. The extract of the U. S. Ph. is an ingredient of *pilulæ catharticæ compositæ* (U. S. Ph.) and *pilulæ catharticæ vegetabiles* (U. S. Ph.). (See CATHARTICS.) Resin of jalap, *resina jalapæ* (U. S. Ph., Ger. Ph.), *jalapæ resina* (Br. Ph.), the purgative principle of jalap, is given in doses of from 2 to 5 grains, and usually in pill. Resin of jalap is an ingredient of *pilula scammonii composita* (Br. Ph.).

[Resin of jalap is incorporated with equal parts of medicated soap to constitute the *sapo jalapinus* of the Ger. Ph., the *pilulæ jalapæ* of which are made with 3 parts of this jalap soap and 1 part of finely powdered jalap. This mass is divided into pills weighing 0·1 of a gramme (a little more than 1½ grain). One or two pills may be given as a dose.]

Compound powder of jalap, *pulvis jalapæ compositus* (U. S. Ph., Br. Ph.), according to the U. S. Ph., is composed of 35 parts of jalap and 65 of potassium bitartrate. According to the Br. Ph., it contains 5 parts of jalap, 9 parts of acid tartrate of potassium, and 1 part of powdered ginger. The dose is from 20 to 60 grains. Tincture of jalap, *tinctura jalapæ* (Br. Ph.), contains 54½ grains of jalap to 1 fl. oz. The dose is from ½ to 2 fl. drachms. It may be used as an addition to cathartic mixtures. Jalap is also an ingredient of *pulvis scammonii compositus* (Br. Ph.).—HENRY A. GRIFFIN.

JAMBOL.—See JAMBUL.

JAMBUL, *jambal*, *jambol*, or *jamboo*, as ordinarily obtained in pharmacy, is a powder derived from *Eugenia jambolana*, a large tree which grows in the East Indies. The seeds are ordinarily supplied, but there is reason to believe that some of the powder is made from the bark. This is not to be regretted, however, for both bark and seed are active, though the former is probably the less potent of the two. Vix (*Therap. Monats.*, No. 4, 1893), indeed, expresses a preference for the bark because of its relative cheapness, the expense of the fruit being an obstacle to its administration in sufficient quantities. Of the bark he uses an extract (process not given), and gives from 4 to 5 drachms of it several times a day with benefit. The seeds contain fat, chlorophyll, resins, an essential oil, albumin, gallic acid, coloured extractive, and water.

The medicinal virtues of the bark and the seeds are *stomachic*, *astringent*, and *antidiabetic*. In India the remedy has long been used in these capacities, but, while its stomachic and antidiarrhœal powers are incidentally useful in many cases, it is as an antidiabetic only that we use jambul. How its action to diminish *glycosuria* is accomplished is at present unexplained, some thinking it a vague and supposititious action upon the vaso-motor centres, while others think it consists in preventing the conversion of starch into sugar. The latter would certainly appear the more reasonable explanation, and experiment has shown that when diastatic material of known capability has been added to starch the further addition of jambul has much diminished the production of sugar. In animals that have been rendered diabetic the administration of jambul has decidedly lessened the quantity of sugar in the urine. As to its value in the *diabetes* of man, opinions differ. In many cases it seems highly efficient, the glycosuria growing less and even disappearing, while the general symptoms are ameliorated. That a curative action is possessed by the drug is not likely, and discontinuance of its use seems always to be followed by a reappearance of the glycosuria. No doubt mild cases show more brilliant results from its employment than severe ones do, and no doubt, too, it must be aided in its action by a rigidly enforced antidiabetic diet, but there seems reason to believe that many of the failures reported from its use have been due to the employment of doses which were insufficient. Some authorities therefore recommend its more generous administration, even to the extent of from 75 to 150 grains in twenty-four hours. That such doses may be disturbing has been thought by some, but the weightier evidence is against the production of harm by it, and its stomachic and corroborant actions have in many cases been conspicuous. The initial dose of jambul is from 5 to 10 grains; that of the fluid extract is at first 10 minims, but this dose may rapidly be increased. This preparation may be given in emulsion or in capsule. Various extracts, both of the seeds and of the bark, are also employed.

HENRY A. GRIFFIN.

JASMINE.—See GELSEMIUM.

JECORIS ASELLI OLEUM.—See COD-LIVER OIL.

JEQUIRITY is the Brazilian name given to the seeds of *Abrus precatorius*. *Abrus* is a genus of climbing shrubs indigenous to India and now naturalized in all tropical countries.

The seeds, *semen abri*, are inodorous and have a slight bean-like taste. They are employed in India as a standard weight (about 1½ grain). They are also used by the natives for the criminal poisoning of cattle, the poison being effected by means of sharpened cones of a dried paste made from the seeds and thrust into the cattle.

The seeds are said to be inert when taken whole into the stomach (Warden and Waddell, of Calcutta). They contain *abric acid*, $C_{12}H_{24}N_3O$, and two proteid poisons, a paraglobulin, and an albumose, which are almost identical in their physiological and toxic properties with similar principles found in snake venom, although less powerful. They are a powerful cardiac poison. A temperature considerably below that necessary to coagulate albumin is sufficient to lower the activity of the poison. Boiling of the watery infusion for an instant renders the poison permanently inert. Professor Warden (1882) isolated from the seeds crystalline abric acid, which is slightly soluble in cold water. An alkaloid, most probably a decomposition product, was ob-

tained by Rigaud and Dusart (1883), and a fixed oil, with cholesterin and lecithin, by Heckel and Schlagdenhauffen (1886). Warden and Waddell (1884) gave the name *abrin* to the proteid compounds referred to above, to which the physiological properties of the seeds are due. It is rendered inactive by moist heat. *Abrin* is probably identical with the *jequiritin* of Bruylants and Veaneman (1885). The paraglobulin of this compound is soluble in a 15-per-cent. solution of sodium chloride. Abrin is readily dissolved by cold water. In glycerin it is also soluble. It is precipitated from its aqueous and glycerin solutions by alcohol. *Jequirity* is said to have been used for centuries in Brazil as a popular remedy for *granular eyelids* and *pannus*, but it was De Wecker, of Paris, who awakened renewed interest in the remedy by his reports of its use in his practice in 1882. A 5-per-cent. infusion of the seed applied to the eye of a rabbit produced violent inflammation, with œdema and false membrane, ulceration of the cornea, swelling of the parotid and submaxillary glands, and finally internal suppuration of the eye and maxillary glands and gangrene of the eyelids. When injected under the skin or into the blood of a rabbit, Cornil and Berlioz showed that it produced, in the former situation, abscess or gangrene, and in the latter violent toxic phenomena, with an enormous generation of bacilli in the blood. The use of jequirity is limited at present to those cases of obstinate *granular conjunctivitis* and *pannus*, especially the latter condition, which have resisted other forms of treatment, and of which some surgeons have attempted to cure by inoculation of the conjunctival sac, with gonorrhœal pus. Its action, therefore, is chiefly substitutive, removing an existing inflammation by the action of a stronger but temporary one.

De Wecker recommended that the remedy be used as follows: Powder 32 jequirity berries and macerate them for twenty-four hours in 500 grammes (1 pint) of cold water; add an equal quantity of hot water and filter when cool. Sattler recommends that the husks of the seeds be removed with hot water before the infusion is made. The seeds are then powdered and 200 c. c. (6 fl. oz.) of hot water added. This infusion is allowed to stand for twenty-four hours, when it is filtered. Andrews recommends that the husks be rejected, the berries ground and macerated in cold distilled water for twelve hours, and that then the infusion be filtered, care being taken to make the preparation in a clean vessel and the maceration to be conducted in a cool place. The *solution should be used fresh.* Decomposition renders it unfit and dangerous to use.

An acute conjunctivitis follows the topical application of the infusion or powdered seeds. Even during the process of pounding the seeds the operator is liable to be afflicted with sneezing, bronchitis, and irritation of the conjunctiva, and any cuts or scratches on the fingers become swollen, painful, and surrounded with an erythematous blush. Professor Sattler, of Erlangen (1883), attributed the inflammation produced by the infusion of the seeds to a specific bacillus. I (*Arch. of Med.*, April, 1884) showed that this view was based on error, as I produced the characteristic inflammation with a sterilized infusion of the seeds. Sattler admitted that the severity of the inflammation was directly proportionate to the strength of the infusion and the number of applications. This is in keeping with the known properties of chemical poisons. De Wecker reported that the jequirity inflammation was peculiar in that it did not tend to spread to the cornea or other tissues, but was confined to the conjunctival sac to which it had been applied. However, instances have been reported where the inflammation spread to the face, the neck, and the upper part of the chest; and Moura, of Brazil, has shown that repeated applications of an infusion (5 per cent.) produce in rabbits such intense inflammation as to result in suppuration of the eyeball and gangrene of the eyelids, and also inflammation of the submaxillary gland. In one of Warren and Waddell's experiments (*Indian Med. Gaz.*, Calcutta, June, 1884) sloughing of the cornea resulted from a single application of a somewhat concentrated infusion of the seeds. *Purulent conjunctivitis contra-indicates* the use of jequirity.

Chronic inflammation of the middle ear and chronic metritis are said to have been cured by jequirity; but the remedy should never, under any circumstances, be used in these conditions. Its use is, as has been said above, limited to rebellious cases of granular conjunctivitis, but more especially to dense pannus. The infusion (3 per cent.), prepared with cold distilled water and used always fresh, is brushed over the conjunctiva with cotton wrapped about a cotton holder, and twenty-four hours are allowed to elapse before the application is repeated. If the powdered seeds are used, a small quantity is dusted over the conjunctiva. Within a few hours after the first application of the infusion the conjunctiva becomes irritated and on the following day it may be severely inflamed; the lids are œdematous, there is a free discharge of watery fluid from the eyes, and a false membrane is seen on the conjunctiva. The period of irritation lasts from three to four days and is attended with fever and pain in the eyes and in the frontal region. Of course these signs will be more or less severe according to the strength of the infusion and the susceptibility of the patient. If the infusion (or powder) gives rise to but slight reaction after twenty-four hours, its use should be continued until the desired effect is produced. A safe rule is to allow at least twenty-four hours to elapse before making the second application.

The *root* of the plant is official in the *Pharmacopœia of India* as a substitute for licorice. *Abrus precatorius* is mentioned in the medical writings of Susrata. It was introduced into the *Bengal Pharmacopœia* in 1844, and into the *Pharmacopœia of India* in 1868.

JOSEPH A. ANDREWS.

JUGLANS (U. S. Ph.), butternut, is the bark of the root of *Juglans cinerea*, a familiar indigenous tree, collected in the autumn. It

contains a minute amount of resin, bitter extractive, salts, and a volatilizable acid in some respects resembling chrysophanic acid and termed *juglandic acid.* Curiously enough, no tannin has been proved to exist in the bark and no alkaloid has been demonstrated.

Juglans is mildly *cathartic* in its action and is unattended by irritant or debilitating properties. It is suitable for administration in *simple constipation*, whether occasional or habitual. It has been thought effective, too, in *dysentery*, and, combined with calomel, has been recommended for use in the *hepatic torpor* which attends malarial infection. The remedy is given in the form of an extract, *extractum juglandis* (U. S. Ph.), of which the dose as a laxative is from 5 to 10 grains, and as a purge from 20 to 30 grains. In Germany juglans leaves are official as *folia piglandis* (Ger. Ph.).—Henry A. Griffin.

JUICES.—Lemon-juice, *limonis succus*, is official in the U. S. and Br. Ph's. The expressed juices of belladonna, conium, hyoscyamus, scoparius, and taraxacum, mixed with enough rectified spirit to prevent their fermentation when kept in a cool place, and filtered, are official in the Br. Ph. as *succus belladonnæ, succus conii, succus hyoscyami, succus scoparii*, and *succus taraxaci.* Mulberry-juice, *mori succus* (Br. Ph.), is used in the preparation of syrup of mulberry. The expressed juices of juniper and licorice, inspissated, constitute the *succus juniperi inspissatus* and the *succus liquiritiæ* of the Ger. Ph., which authorizes also a purified preparation of inspissated licorice-juice under the name of *succus liquiritiæ depuratus.* For the animal juices, see Animal extracts and juices.

JUNIPER.—The berries of *Juniperus communis*, juniper berries, are *carminative* and *diuretic.* The oil, which gives the peculiar flavour to Holland gin, was formerly much employed in the treatment of *dropsy.* The dose of the oil, *oleum juniperi* (U. S. Ph., Br. Ph., Ger. Ph.), is from 1 to 4 minims; that of *spiritus juniperi* (U. S. Ph., Br. Ph., Ger. Ph.) is from $\frac{1}{2}$ to 1 fl. drachm. *Spiritus juniperi compositus* (U. S. Ph.) bears a close resemblance to Holland gin; the dose is from 2 to 4 fl. drachms. The dose of the inspissated juice, *succus juniperi inspissatus* (Ger. Ph.), *roob juniperi* (Austr. Ph.), is from $\frac{1}{2}$ to $\frac{2}{3}$ of a grain.

JUTE, by itself or impregnated with an antiseptic, has been used as a surgical dressing. It has been thought to be more absorbent than cotton.

KAIRINE is an artificial alkaloid derived from quinoline and represented by the formula $C_{11}H_{15}NO.HCl$. It is probably the most active *antipyretic* of all the derivatives of the coal-tar products, but its use is unfortunately attended by considerable danger, as it is a very powerful cardiac depressant. It also retards the respiration and in large doses has caused chills and epileptoid convulsions. In doses of from 4 to 5 grains, every hour, it causes a very rapid decline of high temperatures, but its effects are very temporary, and as soon as its influence begins to subside the temperature quickly rises to its former height. A mixture of equal parts of this body and of antipyrine is much more prompt in its antipyretic effects than a similar amount of either drug used by itself. Its bitter saline taste and irritating effects upon the throat render its administration very unpleasant. It has been given in 5-grain doses every hour until defervescence in *fevers* has occurred, and continued in somewhat smaller quantities as long as seemed necessary, its action upon the heart and respiration being carefully noted. Although it was used to a considerable extent upon its first introduction into medicine, it is now almost entirely abandoned, and very properly so, on account of its depressing properties.—Russell H. Nevins.

KALIUM.—See Potassium.

KAMALA (U. S. Ph., Br. Ph., Ger. Ph.), **KAMEELA**, consists of the hairs and powder from the seed capsules of *Rotttera tinctoria*, a shrub found wild in Abyssinia, India, China, Australia, and other Eastern countries, where it is used extensively as an *anthelminthic.* It occurs as a fine, brick-red, somewhat granular powder having many of the physical characteristics of lycopodium. It is usually administered mixed with syrup in doses of from 1 to 2 drachms, every three hours, until the desired effect has been produced, or in an unofficial tincture in doses of from 1 to 3 fl. drachms, repeated as in the case of the powder. Nausea, colic, and purging are not, as a rule, caused by it, and to insure success it must be followed by a cathartic. It is effectual against all forms of *intestinal worms*, but is not held in high esteem outside of the countries in which it is found, aspidium, pomegranate root, and pumpkin seeds being usually preferred. It may be used when other remedies have been tried and have failed, but the preliminary treatment described under anthelminthics must previously be undertaken. (Cf. Anthelminthics.)—Russell H. Nevins.

KAVA, KAVA-KAVA. — This drug, which has been known by the various names of *ava, ava-ava, ava-kava, kava, kava, kaua-kaua, kawa-kawa, kawa, yangona*, and *kava-kava*, consists of the large fibrous roots of *Piper methysticum*, a shrub of the natural order *Piperaceæ* found in the Sandwich, Fiji, and other islands of the Southern Pacific Ocean. Several varieties of this species exist, and it is said that the variety which contains the most active properties grows on dry soil.

It is an *anæsthetic, motor depressant, diuretic*, and *siatagogue.* The aborigines of the islands in which it grows prepare from it with water or cocoanut milk a beverage which is said by most writers to plunge them into a drowsy condition frequently attended by erotic dreams and followed by severe headache with great susceptibility to noise. Kesteven (quoted by Cerna) is of the opinion that this is not a condition of drunkenness. He maintained that, although inco-ordination of the motor system is produced, the intellect remains un-

clouded, and he denies that the debauch is followed by headache or other disagreeable after-consequences.

Attention was first called to kava-kava by Morson in 1844. In 1860 Gobley isolated a resin which he called methysticin, but until very lately little or no use has been made of the drug. According to Cerna, who has given in the *Therapeutic Gazette* for January, 1891, the best description we have of the physiological action of kava-kava, its internal or hypodermic administration is soon followed by loss of both local and general sensibility, together with muscular weakness or paralysis and a copious secretion of saliva. After a while the general sensibility gradually returns, and later the muscular affection passes away, but the local anæsthesia about the point of a hypodermic injection persists until after all the other symptoms have disappeared. In small and moderate doses it stimulates, but in large amounts it depresses, the nervous system. It diminishes and finally abolishes reflex action and produces motor and sensory paralysis, probably by means of its action on the spinal cord. Small doses slightly elevate, large ones depress, the bodily temperature. A diminution of the rate of the heart-beat and of the arterial blood-pressure is always caused, and yet the heart-waves are larger, which shows that there is a certain amount of cardiac stimulation. After small and moderate doses the cardiac rate gradually returns to normal, but never rises above that point; after large ones the reduction is progressive till death. If the administration of the drug is preceded by section of the pneumogastrics, the blood-pressure rises, a fact which indicates that the lowering of the blood-pressure is due to a powerful action of the drug upon the cardio-inhibitory centres. Small and moderate doses stimulate, but poisonous ones paralyze respiration, and death results from either respiratory or cardiac paralysis.

When applied locally to a mucous membrane it causes a burning sensation soon followed by a local anæsthesia which endures for hours and then slowly passes away. This effect is probably due to a direct action upon the peripheral ends of the sensory nerves.

The active principle of kava-kava has not yet been determined, and not very much is known about its constituents or their action. It contains two crystalline principles, two resins, and a volatile oil. *Kavahin*, otherwise known as *avahin*, *kavain*, and *methystin*, is a neutral principle which occurs in small, white or colourless, odourless, and tasteless silky needles, and is insoluble in water and but slightly soluble in cold alcohol or ether. *Yanconin* is a similar crystalline principle of a pale-yellow colour.

The two resins are usually known as the α-kava and the β-kava. The α-kava resin, which also bears the names of kawin and lewinin, is a thin, acrid, oily, yellowish-green substance, soluble in petroleum ether. It has a pungent, aromatic taste and a pleasant odour.

In regard to the action of any of these derivatives there is great doubt. Some observers have concluded that each of them, unless inert, produces similar effects to those of the crude drug. Others are inclined to ascribe the diuretic action of the drug to the volatile oil together with one or both of the resins, and its action upon the nervous system to the crystalline principles, but this seems rather to be pure hypothesis than to be based on scientific research.

Although kava-kava is employed mainly on account of its diuretic and antiblennorrhagic action, very little is known of its *modus operandi*. It exercises a favourable influence on the mucous membrane of the genito-urinary tract, and may be used as an antiblennorrhagic even in the acute stage of urethral inflammation. It has been recommended in *gonorrhœa*, *gleet*, *elytritis*, *acute* and *chronic cystitis*, *retention* and *incontinence of urine*, *gout*, and *dropsy*.

As a local anæsthet it has been suggested that it may prove of value in dentistry. The pain which attends its first instillation into the conjunctival sac precludes its success as a rival to cocaine in ophthalmic work, but after anæsthesia of the cornea and conjunctiva has been obtained it may be prolonged by kava-kava. Its taste is pleasant, so it may be used to disguise the taste of bitter or nauseous medicines.

Kava-kava is not official. The fluid extract may be used in doses of from 15 minims to a fl. drachm, or the infusion in doses of from ½ to 1 fl. drachm.—Matthias Lanckton Foster.

KEFIR, or *kefyr*, or *kephir*, is a Caucasian product made by fermenting the milk of cows or other animals. The ferment employed is said to be the *Bacillus caucassicus*. Kefir is used for the same purposes as kumyss.

KERATIN, or *ceratin*, *keratinum* (Ger. Ph.), is a peculiar substance contained in the epithelial or cuticular structure of animals, particularly in the nails, horns, claws, hoofs, feathers, hairs, etc. It belongs to the class of albuminoids, and contains usually a small percentage of sulphur, which seems to be, however, only loosely combined. Its exact composition has not been determined. Obtained in as pure a state as possible, it is amorphous and insoluble in alcohol, ether, or cold water. When heated with water, under pressure, at a temperature between 150° and 200° C. (302° and 392° F.), it is dissolved. It is also slowly dissolved by alkaline liquids, especially when warm, and by strong acetic acid. Neither pepsin nor trypsin exerts any action upon it. It is this last-named property which has led to the use of keratin in therapeutics and pharmacy. When it is desired to convey to the upper portion of the intestinal canal, by way of the mouth, certain remedies which, on their passage through the stomach, would be attacked by the gastric juice, such remedies are best enveloped in a capsule or coating of keratin. This remains unchanged until the alkaline contents of the duodenum are reached, when the coating is slowly dissolved and the inclosed remedy becomes free to act.

The Ger. Ph. directs keratin to be prepared

in the following manner: 10 parts of scrapings of quills are digested in a closed flask during eight days in a mixture of 50 parts each of ether and alcohol, the whole being frequently agitated. The liquid is then poured off, the residue well washed with lukewarm water, and then covered with a solution of 1 part of pepsin and 5 parts of hydrochloric acid in 1,000 parts of water. The mixture is kept at a temperature of about 40° C. (104° F.) during one day, being frequently agitated. The liquid having then been poured off, the residue is well washed and dried. The dry mass is now boiled in a flask provided with a reflux condenser for thirty hours with 100 parts of acetic acid of about 96 per cent., whereby all the keratin goes into solution. The mixture is separated from the undissolved matter by filtration through glass-wool and the filtrate evaporated to a syrupy consistence in a porcelain capsule, then spread upon plates of glass and dried. The product appears as a brownish-yellow powder or laminæ, without odour or taste, insoluble in the ordinary solvents or dilute acids, but readily soluble in alkalies, ammonia, and concentrated acetic acid.

In preparing keratinized pills, the mass should be made without water, if possible; preferably with the intervention of a little fat. They are then rolled or dipped in a solution of 1 part of keratin in 10 parts each of ammonia and water, and allowed to dry. One or two more coats are then applied in the same manner.—Charles Rice.

KERMES MINERAL.—See under Antimony, page 114.

KEROSENE.—This well-known illuminating oil is sometimes used topically as an *insecticide* and as a stimulating application. Dr. A. Schirman (*N. Y. Med. Jour.*, Dec. 7, 1895), has employed it in cases of *wounds* and *ulcers* in persons of the poorer classes that had been treated, according to the pathological septic conditions, by the usual antiseptic methods, but were progressing very slowly, on account of the fact that time and circumstances did not allow the patient to apply these preparations as often as necessary.

In cases of ulcers, especially *atonic* and *indolent ulcers*, Dr. Schirman smears them with commercial kerosene, either pure or diluted (from 33 to 50 per cent.) with alcohol, with a small camel's-hair brush or with a piece of gauze soaked in the solution. Shortly after the application a burning sensation is felt, but it soon passes away. The appearance and character of the ulcers show a change for the better; the discharge gradually diminishes, and in the course of from two to four weeks the surface heals rapidly, forming a scar without any contraction of the surrounding parts. In such cases, says Dr. Schirman, kerosene produces healing in a comparatively brief space of time; it is economical and easily obtained; he has never found the wound to be complicated with any erysipelatous process: it does not produce constitutional poisoning through the wound by absorption, as other antiseptics sometimes do; it has not the intolerable smell of some of the others which are now in use; and the formation of a cicatrix on the ulcers is rapid.

KINESIOTHERAPY.—See under Exercise, page 413.

KINO (U. S. Ph., Br. Ph.).—East Indian kino is the juice of *Pterocarpus Marsupium*, a leguminous tree of the East Indies, obtained from incisions into the trunk and inspissated without artificial heat. Several varieties of kino are found in commerce, and the confusion which attends both its geographical and botanical origin is considerable. The well-recognised commercial varieties of kino are the West Indian, the South American, the African, the Australian, and the East Indian or Malabar. The last named is the best and is the only one recognised by the U. S. Ph. and the Br. Ph. It is soluble in alcohol, but only slightly soluble in water. The active properties of kino reside in its tannic and gallic acids, the former occurring plentifully in the drug, the latter scantily. Further than these, its constituents are not therapeutically important, but among them is a crystallizable substance called *kinoin*, together with *kino-red*, its anhydride.

The physiological action of kino is that of its constituent, tannic acid, and its uses are as a powerful *astringent*. It is much used in *diarrhœas* due to intestinal relaxation. In acute inflammatory diarrhœa it is contra-indicated. In *passive hæmorrhage* from the intestines it is valuable. As an astringent in conditions which can not directly be reached by it it is inferior to gallic acid, but is nevertheless employed in *passive hæmorrhages* from the viscera, in *leucorrhœa*, and in *polyuria*. Locally applied, it exerts an astringent action that is valuable in *relaxed conditions of the mouth and throat* as well as in *epistaxis*. The powder may be serviceable when applied to *indolent ulcers*.

The tincture of kino, *tinctura kino* (U. S. Ph., Br. Ph.). may be given in doses of from ½ to 2 fl. drachms. It is much used in combination with chalk mixtures. Compound powder of kino, *pulvis kino compositus* (Br. Ph.), contains 15 parts of powdered kino, 1 part of powdered opium, and 4 parts of powdered cinnamon bark. The dose is from 5 to 20 grains. Kino is also an ingredient of the *pulvis catechu compositus* (Br. Ph.).—Henry A. Griffin.

KOCHIN.—Tuberculin. See under Animal extracts and juices, page 81.

KOLA.—See Sterculia.

KOUMYS.—See Kumyss.

KOUSSO.—See Cusso.

KRAMERIA (U. S. Ph.), *krameriæ radix* (Br. Ph.), *radix ratanhiæ* (Ger. Ph.), rhatany, is the root of *Krameria triandra* (Peruvian rhatany) or of *Krameria ixina* (Savanilla rhatany), small shrubs growing in South America, and especially in Peru and Bolivia. The Ger. Ph. recognizes *Krameria triandra* only. The bark of the root is strongly astringent in taste but is practically devoid of odour. The woody part is without odour and taste, and is relatively inactive; the smaller roots are therefore

preferred as having a larger proportion of bark. Krameria contains tannic acid (krameria-tannic acid), gum, starch, sugar, lignin, and a peculiar acid called *krameric acid.* An alkaloid has also been isolated and is called *ratanhine.* The active ingredient of krameria, however, is tannin.

The physiological action of krameria is that of a powerful astringent, and its therapeutics is practically the same as that of kino. Thus, it is given in *chronic diarrhœa*, in *dysentery*, and in *passive bleeding from the intestines.* It is also used internally in other *viscereal hæmorrhages*, if passive, and for *leucorrhœa.* It is applied locally to *relaxed mucosæ*, and especially those of the mouth and throat. Of powdered krameria from 20 to 30 grains may be given, or a decoction made with 1 oz. to 1 pint may be preferred, in doses of from 1 to 2 fl. oz. The aqueous extract, *extractum krameriæ* (U. S. Ph., Br. Ph.), is given in doses of from 5 to 20 grains. Of the fluid extract, *extractum krameriæ fluidum* (U. S. Ph.), the dose is from 10 to 60 minims. Troches of krameria, *trochisci krameriæ* (U. S. Ph.), contain almost a grain of extract of krameria in each. They are useful in *chronic pharyngitis.* Tincture of krameria, *tinctura krameriæ* (U. S. Ph., Br. Ph.), *tinctura ratanhiæ* (Ger. Ph.), is given in doses of from ½ to 2 fl. drachms. Infusion of rhatany, *infusum krameriæ* (Br. Ph.), is made with 1 part of krameria and 20 fl. parts of boiling distilled water. The dose is from 1 to 2 fl. oz. Krameria is also an ingredient of *pulvis catechu compositus* (Br. Ph.). The syrup, *syrupus krameriæ* (U. S. Ph.), is made by adding 55 parts of syrup to 45 of the fluid extract. The dose is from 20 to 120 minims.

HENRY A. GRIFFIN.

KRESIN is the name of a German proprietary *antiseptic* and *disinfectant.* It is described as a brown liquid having the odour of cresol, readily miscible with water in all proportions. It is said to be less poisonous than carbolic acid.

KRISTALINE.—See CRISTALLINE.

KUMYSS.—Fermented milk has been used as a food from very ancient times, chiefly by the nomadic tribes of the East. The Tartars, the Scythians, and the various tribes inhabiting the Steppes convert milk into the substance known as kumyss. It is closely allied to the *kefir*, or *kephir*, of the Caucasian mountaineers, the *leban* of the Arabians, and the *yaourt* of the Turks. The kumyss of the Russian tribes is prepared almost exclusively from mare's milk, but cow's milk is sometimes used by them. The milk of the mare contains less casein and fat and much more lactose than that of the cow. It undergoes fermentation much more readily, therefore, than cow's milk, and can be kept for but short periods of time. As the wealth of the nomadic tribes consists largely of herds of horses, it is readily understood why the use of fermented milk should be so universal among them. The kumyss of the Steppes is made by continually adding to the milk skin-bags fresh milk as the kumyss is withdrawn, the bags never being washed. It undergoes a true alcoholic fermentation, the lactose being broken up into alcohol and carbonic acid. The kumyss cure, in which the patient is sent out on the Steppes, has been vaunted as extremely efficacious, but the climate and the life in the open air are undoubtedly factors of very great importance in securing the favourable results. It is a mode of treatment, however, which has but little interest for the American physician.

A milk preparation called kumyss has, during recent years, come into extensive use in the United States. There is no reason to suppose that the word is not properly used when applied to milk which has undergone alcoholic fermentation. There is, further, no reason to suppose that kumyss, prepared scientifically, is not as valuable a dietetic agent as that prepared by a half-civilized tribe in dirty skin-bags. It is certainly more cleanly and wholesome.

Kumyss is defined in the *Proceedings of the American Pharmaceutical Association* as a "beverage prepared by fermenting cow's milk with yeast and sugar, in bottles closely corked, for six hours at a temperature of 75° to 90° F., and then transferred to a cool place."

The *National Formulary* gives the following directions for its preparation:

Cow's milk, fresh........	32 fl. oz.;
Yeast, semi-liquid.......	60 minims;
Sugar..................	1 troy oz.

Dissolve the sugar in the milk, contained in a strong bottle, add the yeast, cork the bottle securely and keep it at a temperature between 23° and 32° C. (75° to 90° F.) for six hours: then transfer it to a cool place. The following formula is advised by Wolff:

Grape sugar.............	½ oz.;
Compressed yeast........	20 grains;
Water..................	4 oz.;
Milk......enough to make	1 quart.

Dissolve the sugar and yeast in the water and add the solution to the milk contained in a strong bottle, cork it securely, and keep it at a temperature of 50° F. for three or four days, then place it on ice.

Milk readily undergoes alcoholic fermentation under the influence of certain ferments. It is urged that true kumyss should be made from milk modified to resemble mare's milk with the addition of a special ferment. Dr. Brush gives the following method: "To a given quantity of milk I add four per cent. of milk-sugar; take one third of the milk, precipitate from it the casein, and add the resulting whey to the milk I had taken it from; then, to make with this the kumyss, I add a proper ferment, and during the coagulation of the casein the fermenting mass is constantly kept in a state of agitation, which breaks up the casein and leaves it in the condition which it presents in the milk of the non-ruminant animals."

The composition of kumyss is so variable that it is impossible to give any table which will convey an accurate idea of the constituents of any given sample. It varies with the quality of the milk used, the method of preparation, and the length of the period of fermentation.

The casein is somewhat changed, being partially transformed into peptone. It forms into smaller masses than in milk coagulated in the usual manner. Kumyss contains alcohol, carbonic acid, lactic acid, sugar, fat, casein, and salts. The proportion of alcohol is sometimes as great as three per cent.

As a food, kumyss is highly nutritious and very easily digested and assimilated. If too fresh, it is apt to produce colic and flatulence. If too old, it causes constipation. It is strongly *diuretic*, and, owing to the presence of the alcohol, distinctly *stimulating*. It is frequently tolerated by the stomach when every other form of food is rejected. It possesses the power to a marked degree of improving nutrition, and is one of the most efficient fat-producing foods at our command. It is therefore well adapted for use in wasting diseases, and has obtained a well-deserved reputation in *phthisis*, *chronic bronchitis*, and *diseases of the stomach and bowels*. It often proves a most valuable article of diet when the stomach is irritable and digestion impaired. Owing to its thirst-allaying powers it is valuable in *acute febrile conditions*, and is also largely used in the *convalescence of acute diseases*. It is very extensively used by abdominal surgeons, for, as a rule, no other article of food is better tolerated by the stomach or causes less disturbance after operations. It is not well adapted to the use of young infants, but in the *wasting diseases* and conditions of *impaired digestion* so common in children over six or eight months old it sometimes proves of the utmost value.

[Dr. John H. Girdner (*N. Y. Med. Jour.*, Jan. 12, 1895) says he not infrequently finds patients who dislike kumyss on account of its acid taste, and who object to matzoon because it "lies heavy on the stomach." This has led him to try a mixture of the two, and after considerable use of a mixture of equal parts of these two articles of diet he believes such a mixture is not only more palatable but more nutritious than either preparation when taken by itself.]—Floyd M. Crandall.

LABURNUM.—See Cytisus Laburnum.

LAC (Br. Ph.).—See Milk.

LACTIC ACID, *acidum lacticum* (U. S. Ph., Br. Ph., Ger. Ph.), is an organic acid produced by the lactic fermentation of sugar and containing about 75 per cent., by weight, of absolute lactic acid, $HC_3H_5O_3$, and 25 per cent. of water. It is a syrupy liquid without colour or odour, but of a pure acid taste. It absorbs moisture from damp air, and is miscible in all proportions with water and with alcohol.

Locally applied, lactic acid is a *solvent* of false membranes and a *catheretic* to ulcerations and callosities. Its application in full strength to mucous surfaces and highly organized tissues is mildly *caustic*. The acid possesses some slight *antiseptic* power. The gastric juice normally contains a small amount of lactic acid, and in apeptic and some dyspeptic conditions, therefore, it is a physiological remedy. In large doses it is irritant and productive of epigastric pain and flatulence. As lactic acid is believed to occur free in the blood in some diseased conditions, the suggestion that its excess there is responsible for rheumatic manifestations is of much interest. This interest is the greater because the experimental injection of the acid into the peritonæum in dogs has been followed by endocardial inflammation, and because its continued employment in considerable doses in man has been followed by symptoms resembling those of rheumatism. This belief is, however, not generally entertained, and most authorities prefer to think the lactic-acid accumulation an accompaniment or an effect rather than a cause of rheumatism. Because of its relation to normal digestion lactic acid has been administered in *atonic dyspepsia*, and often in combination with pepsin. In *gastric superacidity* the remedy may be useful, but here its administration should be before meals, that diminution of gastric secretion may occur; not after meals, as is proper in deficiency of gastric secretion. *Diarrhœal conditions* are sometimes benefited by the acid, among them *tuberculous diarrhœa*, but especially the *diarrhœa of children*, in which the movements contain undigested food, and often are green in colour. The fact that freshly precipitated calcium phosphate may be redissolved by lactic acid has led to the use of this drug in *phosphaturia*, and even in cases of gross *phosphatic deposit*. Other urinary deposits have also been thought to be corrected by its use, but irrationally, unless they were manifestations of faulty digestion which it has served to remove. The supposed hypnotic action of lactic acid is ingeniously explained by attributing sleep to the presence of the products of tissue metamorphosis in the blood. Of these products lactic acid is one, and hence it has been recommended as a soporific. Unfortunately, the explanation, though ingenious, can not make the acid a reliable hypnotic, and to cause sleep it is but little employed. Like many another drug, lactic acid has been highly extolled as a remedy against *diabetes*, but, like most of its associates, it has been conspicuous for its failures. Moreover, the continued use of the large doses which this disease requires may be disadvantageous, and perhaps injurious.

The chief value of the remedy, therapeutically, resides in its local application. From its action to dissolve false membranes, solutions which contain it have been used in *croup* and *diphtheria*, both as gargles and as sprays. For spraying, a 4- or 5-per-cent. solution will be appropriate; for gargling or swabbing, the solution may be somewhat stronger. *Tuberculous laryngitis* is remarkably benefited by the application of lactic acid. The solutions employed vary in strength up to the undiluted acid, but the first applications should not exceed 50 per cent. in strength, and should be gradually made stronger, lest otherwise inflammatory reaction be too great. The applications are made every other day at first, then every day, by means of a brush, the parts having previously been cleansed and cocainized. A considerable amount of burning pain may re-

sult and last for several hours. In the same way *nasal* and *lingual tuberculosis* have been treated. Lactic acid in a concentrated form, or combined with salicylic acid, has been recommended for the slow destruction of such lesions as *lupus*, *epithelioma*, *tuberculous ulcerations*, and *papillomata*.

The dose of lactic acid is from 15 to 30 minims, well diluted. Diluted lactic acid, *acidum lacticum dilutum* (Br. Ph.), contains 15 parts of lactic acid and enough distilled water to make 100 parts. The dose is from ½ to 2 fl. drachms. Lactic acid is an ingredient of *syrupus calcii lactophosphatis* (U. S. Ph.).

The incompatibles of lactic acid are alkalies and mineral salts.

[Lactic acid has been thought to exercise a destructive action on diseased tissue, leaving healthy structures unaffected. Dr. Delshenkoff (cited in the *Lancet*, June 8, 1895) has found it very useful as a local application in *corneal ulcers*. In chronic cases, with *intense photophobia* and marked hyperæmia of the vessels surrounding the cornea, a single application of a 50-per-cent. solution of lactic acid, made with a pointed bit of wood, generally enables the patient to bear the light quite well, and sometimes is sufficient to prevent the ulcer spreading, especially if it has not already attained any considerable dimensions. An eschar is of course formed, which falls off in three or four days, revealing a healthy base, which is seen to be already commencing to cicatrize. The application of the acid is not painful, and if by accident a healthy part of the conjunctiva is touched, the effect is so slight that by the next day the epithelium will be found to be replaced.]

Henry A. Griffin.

LACTOL, LACTONAPHTHOL.—This preparation, described as lactic ether of naphthol, has been prepared by a French chemist, M. Coez, who reports that he has taken 15 grains of it daily for several days in succession without feeling the least inconvenience. It is said to be tasteless and to split up in the digestive canal into lactic acid and naphthol. No reports on its therapeutical properties have yet been published.

LACTOPEPTINE.—This is an American proprietary preparation said to consist of pepsin, pancreatin, lactic acid, hydrochloric acid, diastase, and sugar of milk. It is used for the same purposes as pepsin.

LACTOPHENINE, or *lactylphenetidine*, is a derivative of phenacetine in which lactyl replaces acetyl. Its formula is given as $C_6H_4\begin{matrix}\nearrow OC_2H_5 \\ \searrow NH.CH_2.OH.CH_2.CO.\end{matrix}$ It is a white, crystalline powder, odourless, of a slightly bitter taste, soluble in 330 parts of water. It has been used as an *antipyretic*, *analgetic*, *antirrheumatic*, and *hypnotic*. The antipyretic dose is about 8 grains; the hypnotic, 15 grains. Von Jaksch thinks it has a soothing effect quite apart from its action as an antipyretic and analgetic. It is said to be comparatively harmless: Cadéac (*Lyon méd.*, Dec. 8, 1895) has found it to produce mild diarrhœa occasionally, but this, he remarks, is rather beneficial in many febrile diseases. It has been used in *typhoid fever*, *articular rheumatism*, *influenza*, *scarlet fever*, and other acute febrile diseases.

LACTUCA (Br. Ph.).—This is the flowering herb of *Lactuca virosa*, the acrid lettuce of Europe. The dose of the extract, *extractum lactucæ* (Br. Ph.), is from 5 to 15 grains. For its medicinal uses, see Lactucarium.

LACTUCARIUM (U. S. Ph.) is the inspissated milky juice of several species of lettuce. It was formerly held in high repute on account of its assumed *antaphrodisiac* and *soporific* properties. The evidence is that the lettuce used by the Greeks did possess these virtues to a much greater extent than any variety now known. Our common garden variety is reputed to be somewhat soporific when eaten in considerable quantities, but there seems to be little to support this theory beyond tradition. The action of the drug is very capricious. It is absolutely without effect in many cases, but in others it seems to produce slight soporific effects. As an antaphrodisiac it is nearly valueless. It may be given in almost any quantity. It sometimes is useful as a placebo, or when opium and its alkaloids are strongly contra-indicated. The most that can be said for it is that it can do no harm and may do a little good. In slight *irritation of the larynx* lactucarium paste, a French proprietary preparation, is sometimes useful, but whether the benefit derived from it is due to the lactucarium or to its vehicle is somewhat problematical. It is maintained that it will in some cases prevent the *nausea which follows the use of opium and morphine*, and it is well worth a trial for this purpose.

Tinctura lactucarii (U. S. Ph.) is used in the preparation of the syrup, *syrupus lactucarii* (U. S. Ph.), which contains 1 part of the tincture in 10 parts, and is used in almost any desired dose and as a vehicle for cough mixtures. For the extract of lactuca (Br. Ph.), see under Lactuca. The Fr. Cod. orders an opiated syrup of lactucarium of which ½ fl. oz. should contain about $\frac{1}{12}$ of a grain of aqueous extract of opium. A crude variety is said, upon slight authority, to have been the opium of Galen.

Russell H. Nevins.

LACTUCIN is a bitter crystalline principle obtained from the juice of *Lactuca virosa*. The formula has been given as $C_{22}H_{18}O_7$ and as $C_{22}H_{14}O_8$. It has been employed as a hypnotic in doses of from 1 to 5 grains.

LAMELLÆ (Br. Ph.) are gelatin discs containing a medicament for application within the conjunctival sac. Lamellæ of atropine, of cocaine, and of physostigmine are official in the Br. Ph.

LAMINARIA is a genus of dark-spored algæ, or seaweeds, of the order *Laminariaceæ*. The plants have no proper leaves, but "a plain, flat, blade-like, ribless expansion which is either simple or cloven." There are several species, many of which yield iodine in abundance.

Laminaria digitata, tangle, sea-tangle, Devil's apron, grows in shallow portions of the North Atlantic Ocean. Owing to its property of shrinking greatly on drying, and swelling again on absorption of moisture, it has been extensively used in place of sponge tents for dilating the cervix uteri. Pieces of the stalk are turned into smooth pencils half an inch or less in thickness. Introduced into the cervical canal, the pencil becomes soaked with watery fluid and swells to five or six times its diameter in the dry state, and thus expands the cervix. Its advantage over the sponge tent consists in its small size, its distending power, the moderate retention of secretions, and its rigidity. It is now seldom employed in gynæcological practice, however, tents having given place to other means of dilatation.

Laminaria palmata is a variety of *Laminaria digitata*. Charcoal made from this variety of seaweed is said to possess more deodorizing and decolourizing power than animal charcoal.—CHARLES JEWETT.

LANOLIN, *adeps lanæ hydrosus* (U. S. Ph.), is a fatty substance prepared from sheep's wool and consists of a mixture of the cholesterin ether of stearic acid ($C_{26}H_{43}C_{18}H_{35}O_2$) with those of palmitic, oleic, valerianic, benzoic, and probably other acids, and with a resin-like body and colouring matter. In common with the other keratogenous tissues, such as hair, feathers, skins, hoofs, etc., wool contains a peculiar fat which is combined with potassium and known as *suint* (Ger., *Wollschweiss*), and is quite different from the glycerin fats and from the mineral oils. The chief advantages alleged for it over the latter are that, being derived from keratin-holding tissues, it is more readily taken up by the skin when applied externally, is miscible with water, and, furthermore, is not subject, as most glycerin fats are, to decomposition. Wool contains from 30 to 45 per cent. of fat, which is obtained first in the form of an emulsion by means of alkalies. By centrifugal action these separate a thin milky fluid and a thicker creamy substance, which latter is the pure lanolin. It may also be obtained by first thoroughly cleansing the wool and then exhausting it with solvents, such as benzin, benzol, or ether, the solvent being afterward distilled off. The pure lanolin is of a yellowish, light-brown, or greenish-brown colour, of rather tough consistence, and has but a slight odour. It can take up 100 per cent. of water, and then becomes a light-yellow salve. The fat does not dissolve in water, but on the addition of soap and alkalies forms a strong milky emulsion. It readily mixes with glycerin, and in this combination unites with any other fat. When rubbed into the skin it evinces great diffusibility. When a 5-per-cent. carbolic-acid lanolin ointment is rubbed into the back of the hand for a minute or two a feeling of numbness is produced. If a lanolin salve containing corrosive sublimate in the proportion of 1 to 1,000 is rubbed in, it is followed in a few minutes by the characteristic metallic taste in the mouth. It is said, however, that potassium iodide is less readily absorbed—less so than when mixed with vaseline.

The ordinary white lanolin contains 25 per cent. of water. Anhydrous lanolin (*lanolinum sine aqua*) is of a light-brown colour, of unctuous consistence, and of neutral reaction. It melts at 113° F., and forms homogeneous combinations with watery and alcoholic fluids, as well as with fatty and ethereal oils. It does not become rancid, and for this reason forms an excellent base for various ointments. It is said to be a good vehicle for preserving the vaccine virus. It is employed in the preparation of plasters, and especially where large quantities of saline solutions or extracts of fatty substances are to be incorporated in ointments. When drugs in the form of powder are to be used, without water, it is considered best to add 50 per cent. of olive oil or, better, a little vaseline.

For an ointment base (*unguentum lanolini*) it is advised that 65 parts of anhydrous lanolin, 30 of liquid paraffin or vaseline, and 5 of cerasin be melted together and afterward triturated with 30 parts of water; or 66 parts, each, of anhydrous lanolin and liquid paraffin, 1 part of cerasin, and 65 parts of water. Unna found that lanolin, when mixed with a glycerin fat, would take up more water than lanolin alone, and where an evaporating and cooling effect is desired he recommends the following *Kühlsalbe:*

℞	Lanolin.................	10 parts;
	Lard....................	20 "
	Rose water.............	30 "
M.		

And also a "cream" salve (*Rahmsalbe*) with a still larger proportion of water (10 parts of lanolin, 20 of lard, and 60 of rose water). With these may be incorporated various medicaments.

For *mercurial inunctions* the following may be used: 100 parts of mercury, 200 of lanolin, 5 of mercurial ointment, and 50 of lard.

As an injection in *gonorrhœa* 1 part of anhydrous lanolin is mixed with 3 parts of oil of sweet almonds, and to an ounce of this mixture there is added 2 grains of sulphate of zinc dissolved in a scruple of water.

A good *dusting powder* for irritable or inflamed cutaneous surfaces may be made by dissolving lanolin in ether, alcohol, chloroform, or acetone, mixing the solution with carbonate of magnesium, and allowing it to stand till it is thoroughly dry. The mass is then triturated and a sufficient quantity of starch added. Instead of the magnesia, talc or zinc oxide may be used.

[A new German proprietary preparation termed *adeps lanæ* is said by Dr. Georg J. Müller, of Berlin (*Mntsh. f. prakt. Dermatol.*, Jan. 1, 1896), to differ from lanolin in being isolated from the crude fat by a mechanical process, and not by chemical procedures, and to have a melting point lower than that of the crude fat. He speaks of it as a cholesterin fat. He has employed it as a basis for ointments, and finds it non-irritating. He says that for *cosmetic* preparations its consistence

should be reduced by the addition of oil or American vaseline. He quotes Sack as saying that it is capable of taking up three times its weight of water.]—EDWARD B. BRONSON.

LANTANA, LANTANINE.—Lantana is a genus of verbenaceous shrubs. A Brazilian species, *Lantana brasiliensis, yerba sagrada*, yields the alkaloid lantanine, which acts as a *circulatory sedative* and as an *antipyretic.* As an antipyretic, it is given in doses of 1½ grain, from ten to twenty of which are administered in the course of twenty-four hours. It has been recommended as a remedy for *malarial fevers* by Dr. Buiza, of Lima, who says that it is tolerated by the most delicate stomachs, and that intermittent fevers that have proved rebellious to quinine have yielded to one dose of 30 grains of lantanine given immediately after a paroxysm. It is best given in pills or capsules.

LAPPA (U. S. Ph.), burdock root, is a coarse biennial that grows commonly in the United States and Europe. Several species, *Lappa major*, *Lappa minor*, and *Lappa tomentosa*, have been described, but they are simply varieties of the species which should properly be designated *Arctium Lappa.* The seeds and roots, which are used in pharmacy, contain a bitter principle, a volatile oil, arabin, inulin, pectin, etc.

Lappa possesses *tonic*, *laxative*, and slight *diuretic* and *diaphoretic* properties. It has some vogue as an agent for the treatment of *syphilis* and the so-called *scrofulous diathesis.* It is said to be useful in *rheumatism.* The fluid extract, *extractum lappæ fluidum* (U. S. Ph.), is used as an antiphlogistic application to *contusions* and *hæmorrhoids.* It may be of use in the treatment of *psoriasis*, *prurigo*, and some other chronic skin diseases. The fluid extract may be prepared from either the root or the seed, the therapeutic action of the two being apparently identical. The dose is from 15 to 60 minims.

SAMUEL T. ARMSTRONG.

LARCH.—See LARIX.

LARD, *adeps* (U. S. Ph.), *adeps præparatus* (Br. Ph.), *adeps suillus* (Ger. Ph.), is the purified fat of the hog, the fat found over the kidneys and in the mesentery and omentum. As found in commerce at the present time it is rarely pure, containing a considerable proportion of beef stearin. It should be nearly white, inodorous, of a faintly sweet taste, and entirely free from water or salts. When prepared for domestic uses it usually contains water and a small amount of common salt. Alone or mixed with wax, it constitutes the base of nearly all the official cerates and ointments. For this purpose it presents the objection of readily becoming rancid and irritating to the skin, and is being superseded by the various jelly-like preparations obtained from petroleum. It was formerly used extensively to protect raw exposed surfaces, to limit the action of caustics and corrosives, and as a mechanical aid in rubbing any portion of the body, but vaseline and kindred bodies are now preferred if obtainable. As a substitute for cod-liver oil it received some notice at one time, but its use was soon abandoned on account of its great indigestibility. Tablespoonful doses are in some cases decidedly *laxative*, and if it does not produce nausea it works very well for this purpose in children. For all the conditions in which fatty inunctions are indicated it may be used, but its speedily becoming rancid renders it somewhat objectionable for this purpose, and it should be avoided unless nothing else is attainable or economy is a decided object. In cases of *poisoning by acids* or *alkalies* it furnishes a readily obtained protective to the corroded surfaces of the mouth and throat. When melted and given in doses of about an ordinary teacupful it is *emetic*, and as such may be used in emergencies. Melted, it is often used instead of oils in enemata.

Benzoated lard, adeps benzoinatus (U. S. Ph.), *adeps benzoatus* (Br. Ph., Ger. Ph.), is a mildly stimulating ointment which is of an agreeable odour, does not become rancid, and is used as the base of a large number of official ointments. That of the U. S. and Br. Ph. contains 1 part of tincture of benzoin in 50 parts of lard; the Ger. Ph. orders 1 part in 100 of benzoic acid; the Fr. Cod., 1 in 100 of the tincture; and the Austr. Ph., 1 in 25 of the powdered gum. The cerate, *ceratum*, of the U. S. Ph. contains 3 parts of white wax and 7 of lard, and the *unguentum* 2 parts of yellow wax and 8 of lard. Both preparations are used as bases for ointments. The *oleum adipis* of the U. S. Ph. is lard oil, which is sometimes used as a substitute for olive oil in the preparation of ointments.—RUSSELL H. NEVINS.

LARIX.—The inner bark of *Pinus laricis (Larix europæa)* is official in the Br. Ph. as *laricis cortex.* It is of an agreeable odour and balsamic taste. It is classed among the stimulant *expectorants*, and is a very eligible remedy in conditions in which the secretions are tough and adhesive. It also possesses *diuretic* properties, and may be used in all *chronic irritable affections of the genito-urinary tract*, such as *cystitis*, *chronic gonorrhœa*, *spermatorrhœa*, etc. Being somewhat *astringent*, it may be employed in the treatment of *indolent ulcers* and *unhealthy suppurating surfaces.* Like all terebinthinate bodies, it has *anthæmorrhagic* virtues, but in a much less marked degree than the oil of turpentine. All forms of *passive hæmorrhages* and *purpura hæmorrhagica* have been treated with it, but other and more approved remedies are to be preferred if they are obtainable. In nearly all the conditions in which oil of turpentine is indicated this drug may be substituted when a very profound impression is not sought for. It is rarely used except in the form of a saturated tincture, *tinctura laricis* (Br. Ph.), which may be given in doses of from 20 to 30 drops. The tree is the source of larch, or Venice, turpentine. The inner bark of *Larix americana*, or American larch, possesses similar properties, but has been little used.—RUSSELL H. NEVINS.

LARKSPUR.—See STAPHISAGRIA.

LAUDANUM.—See under OPIUM.

LAUREL, *Laurus*, is a generic term that has been applied to several trees that possess therapeutic properties.

The bay laurel, or bay, *Laurus nobilis*, is a tree of southern Europe. Its leaves and berries, *fructus lauri* (Ger. Ph.), which have been employed in pharmacy, contain a volatile oil, a liquid fixed oil, a solid fixed oil, *oleum lauri* (Ger. Ph.), called also *laurostearin*, a camphor called *laurin*, and starch. The leaves, the berries, and the oil are *stimulant* and *narcotic*. The volatile oil, which contains a camphene and eugenic acid, has been recommended as an application in *rheumatism*. An oil is obtained by boiling the fresh fruit in water and pressing the mass, that may be used as an *anodyne* in an ointment. An official ointment in the Fr. Cod. is made with 1 part each of fresh laurel leaves and laurel berries with 2 parts of lard; it is used in *simple erythema*, *simple dermatitis*, *superficial burns*, and *acute eczema*.

The mountain laurel, *Kalmia latifolia*, also called the broad-leafed laurel, and calico bush, is an evergreen that is found in all parts of the United States. Its leaves and berries are possessed of poisonous and narcotic properties, and they contain an acrid principle, resin, fatty matter, wax, etc. They are fatal if eaten by sheep and some other animals, although innocuous when eaten by deer or partridges. The meat of the latter birds that have fed on the berries and leaves has caused nausea, dyspnœa, cardiac irregularity, pallor and coldness, transient amblyopia, and cephalalgia; sometimes fatal collapse has occurred. A decoction may be made with the leaves or berries, or the latter may be incorporated in an ointment, which is said to be useful for *tinea capitis* and other forms of tinea.

The California laurel, *Umbellifera californica*, which is indigenous to California, has been recommended by Dr. L. Mann Hammond as an *anodyne* and *stimulant*. A fluid extract, unofficial, is made from the leaves. It is said to be of use in *megrim*, *cerebro-spinal meningitis*, and *atonic diarrhœa*.

For cherry-laurel, see Laurocerasus.

Samuel T. Armstrong.

LAUROCERASUS, the cherry-laurel, *Prunus Laurocerasus*, is an evergreen tree that is indigenous to Asia Minor and is cultivated in Europe. Its fresh leaves, *laurocerasi folia* (Br. Ph.), are used in medicine. If bruised, they have the characteristic odour and taste of hydrocyanic acid. The leaves contain *laurocerasin*, a compound of amygdalin and amygdalic acid, emulsin, a volatile oil, and hydrocyanic acid; a pound of the leaves will yield about 40 grains of the oil, which resembles oil of bitter almonds. The constituents of the leaves vary with locality, climate, and season.

Cherry-laurel water, *aqua laurocerasi* (Br. Ph.), is distilled from the bruised and macerated fresh leaves; it contains the volatile oil and hydrocyanic acid. Not only is the commercial product likely to be of uncertain strength, but it is liable to deteriorate with age. It is used as an *anodyne* and *antispasmodic*, and has the same therapeutical properties as bitter-almond water, which it closely resembles in taste. The dose is from 15 to 60 minims.—Samuel T. Armstrong.

LAURUS.—See Laurel.

LAVAGE is a washing or laving, as of the bladder, the large intestine, but especially the stomach; the evacuation of the contents of the stomach, followed by cleansing by water or medicated solutions. The modern practice we owe to Kussmaul, who used hard tubes and aspiration (the stomach pump). At present only soft-rubber tubes (Oser, Faucher) or tubes made of braided silk are used, and the contents withdrawn by siphon action. In the practice of lavage the patient should be seated. At first it is well to have a mackintosh sheet over the clothing; after a little experience a towel or napkin will suffice to protect the clothing. The tube should be at least a yard and a half long, from 12 to 15 mm. in outside diameter, the lumen from 8 to 10 mm. in diameter. (For children soft-rubber catheters, No. 10 to 15 of the American scale, may be used.) Near one end, which should not be closed, a large and several smaller lateral windows should be cut. The edges of all the openings must be smooth. At a point from 60 to 65 cm. (23·5 to 25·5 inches) from the fenestrated end a mark should be made indicating the average distance from the incisor teeth to the cardia. One may measure the distance in any particular case by taking the distance from the ninth dorsal spine to the incisors. If the tube is not long enough, it should be connected with a piece of tubing of at least equal calibre by a short piece of glass tube. With a tube sufficiently long the glass is not necessary. In using the tube the operator stands in front of the patient, holding the tube, the lower end of which is moistened with water (not greased). Then, the patient having been told to open the mouth and breathe quietly, the end of the tube and the left index finger are passed to the posterior wall of the pharynx. At once the end is depressed with the index finger, and the tube pushed along under the guidance of the finger tip until the end meets the constricted bottom of the pharynx. The patient is then told to swallow (as in swallowing saliva), when the tube will be felt to descend. The swallowing motion is to be repeated, the tube being pushed gently so that the operator feels the way to a certain extent, until, from the lessened resistance, it is felt that the cardia is reached. The patient should then be allowed to breathe for a few moments before any further procedure is begun. With a patient fairly self-possessed, if reassured, or the operation explained before it is begun, there is rarely any difficulty. Occasionally, especially with an awkward or nervous operator, slight or severe retching will be set up when the finger and tube are in the mouth, but if the movements are bold and certain this rarely happens. Again, when the end of the tube reaches the lower part of the œsophagus there is often a sensation of nausea, though vomiting at this stage is rare. Vomiting occurs sometimes when the tube enters the stomach, and in rare cases the accident

occurs so suddenly that the tube may be thrown up. In nearly all cases salivation comes on while the tube is in the mouth, and when the tube is kept in the stomach too long, or pushed too far, regurgitation of bile and intestinal juice or contents takes place. The tube being in the stomach, the next thing is usually the "expression" (Ewald and Boas) of the contents. In order to effect this, the inexperienced patient is told to cough, or to make expulsive movements, as in defecation, or the operator may even make gentle pressure over the stomach region. Experienced patients can usually force out the contents of the stomach with considerable ease. In rare cases, however, removal of the contents by expression is not possible, and it is necessary to connect an aspirating apparatus with the tube and remove the contents in this way. Any aspirator (a bulb syringe, for example) answers this purpose. For the next part of the operation, or the lavage proper, a large glass funnel (of a capacity of at least a quart) is inserted into the outer end of the tube. It is held a little above the level of the patient's stomach, and water, slightly warmed usually, is poured in to the amount of about a pint. The funnel is then raised slightly until the water runs down the tube into the stomach. The funnel is then lowered, still in the upright position, until it is below the level of the stomach. If the tube is not obstructed, the water, with some of the contents of the stomach, flows into the funnel. This is inspected and either kept for further examination or poured out. The process of filling and emptying is then repeated until the water comes away clear. It is important to see that as much water comes out as is poured in (a small quantity may be allowed for as escaping through the pylorus), otherwise the stomach may be left uncomfortably full of water. It is sometimes useful to have the patient change his position, in order to wash out all the folds and recesses of the stomach, though this is usually accomplished by changing the level of the funnel so as to set up currents in the stomach. Experienced patients often prefer to swallow the water beside the tube, letting it run out through the latter. There are other ways of introducing the water, for which special works may be consulted.

The objects of lavage are: 1. In diagnosis, beside the removal of some of the stomach contents for testing, in order to remove as far as possible all the contents, and to measure the capacity of the stomach by filling it and measuring the fluid removed. 2. In treatment: In *dilatation of the stomach*, in order to remove stagnant or injurious matter; in *chronic gastritis*, especially in cases with much mucus or with fermentation; in *acute indigestion* from any cause, in order to remove the contents and cleanse the stomach, a procedure preferable to the use of emetics; in *intoxications;* in *supersecretion;* in electrization of the stomach. In various forms of stomach disease the mechanical action of lavage is useful, especially when used as the "stomach douche." In *gastralgia* and in uncomplicated *motor disturbances of the stomach* the douche is useful, especially with the tube recommended by Rosenheim, which has a large number of fine openings and no large one. This is used on the empty stomach, water at from 100° to 110° F., or medicated solutions being used, according to the nature of the case.

Dangers and accidents: Properly carried out, lavage involves no danger and but little discomfort in the great majority of cases. The possibility of accidents, however, should be borne in mind. One of the accidents first pointed out by Kussmaul as possible is tetany, about twenty-five cases of which have been reported. Three forms of convulsive seizure have been described—simple rigidity of the muscles of the extremities, tetanic convulsions, and true epileptic seizures (Bouveret and Devic). Seventy-two per cent. of the cases terminated fatally (Fenwick). In rare cases syncope and sudden death occur, due perhaps to sudden changes of pressure in the stomach. Perforation and hæmorrhage are possible in all cases of ulcer, whether simple or malignant, and the physician must acquire the habit of making a most careful inquiry into the possibilities before passing a stomach-tube. In cancer the tube may with care be passed for diagnosis or treatment, but lavage is seldom indicated. In a few cases drugs introduced in lavage (such as boric acid) have produced poisonous symptoms.—George Dock.

LAVANDULA (U. S. Ph., 1880), *flores lavandulæ* (Ger. Ph.), lavender flowers, the flowers of *Lavandula vera*, a small shrub native to southern Europe but cultivated widely both in Europe and in America. The flowers have a fragrant odour, which they retain when dried, and an aromatic, bitter taste. The odour of the flowers is due to the volatile oil they contain, and this oil is their therapeutical principle, the flowers themselves not being used in medicine.

Oil of lavender, *oleum lavandulæ* (Br. Ph., Ger. Ph.), is the volatile oil distilled from the flowers of *Lavandula vera*, but the Br. Ph. demands that the distillation shall occur in Britain. To this oil the oil of lavender flowers, *oleum lavandulæ florum* (U. S. Ph.), is superior. It is obtained by distilling the fresh flowers of *Lavandula officinalis*. No very appreciable differences, however, exist between these oils, and the oil in each case appears as a pale-yellow or colourless liquid, with the odour of lavender flowers and a hot, pungent, and bitter taste. It is soluble in alcohol.

Oil of lavender is much used as a perfume, but is possessed also of medicinal properties of some value. Like others of the aromatics, it is *carminative*, *stomachic*, and slightly *stimulant*. It may therefore be employed in *digestive atony* and *flatulence*. It has been recommended, too, in *nervous exhaustion* and *headache*, but its chief medicinal use is as a corrigent addition to other remedies, serving to make them more agreeable and tolerable both to the stomach and the palate. The dose is from 1 to 4 minims. Spirit of lavender, *spiritus lavandulæ* (U. S. Ph., Br. Ph., Ger. Ph.),

according to the U. S. Ph., is a 5-per-cent. solution of oil of lavender flowers in deodorized alcohol. It is used chiefly as a perfume. The British preparation is a 2-per-cent. solution of oil of lavender in rectified spirit. The dose is from 30 to 60 minims, given in sweetened water. It is serviceable as a *stimulant* and *carminative*. The German spirit is made by macerating 1 part of lavender flowers in 3 parts each of alcohol and water for 24 hours and obtaining 4 parts of the mixture by distillation. Compound tincture of lavender, *tinctura lavandulæ composita* (U. S. Ph., Br. Ph.), is made, according to the U. S. Ph., with 8 parts of oil of lavender flowers, 2 of oil of rosemary, 20 of cassia cinnamon, 5 of cloves, 10 of nutmeg, 10 of red saunders, 700 of alcohol, 250 of water, and enough diluted alcohol to make 1,000. The British preparation is made from 1½ fl. drachm of oil of lavender, 10 minims of oil of rosemary, 150 grains of bruised cinnamon bark, 150 grains of bruised nutmeg, 300 grains of red sandalwood, and enough rectified spirit to make 2 imperial pints. The dose of either preparation is from 30 to 60 minims, and it may well be given in sweetened water or dropped upon sugar. Compound tincture of lavender is much used as an adjuvant and corrigent to other remedies, but is an agreeable and efficient remedy in *nausea* and *flatulence* as well.—Henry A. Griffin.

LAVEMENTS.—See Enemata.

LAVENDER.—See Lavandula.

LAXATIVES. — Foods and medicines which gently hasten the excretion of the fæces are termed laxatives. They make the stools softer and more frequent without causing a noticeable irritation of the intestines. The action of laxatives is not accompanied by the griping of the severer purgatives, or by the watery stools of the hydragogues, or by the intestinal catarrh of the drastics. Small doses of many purgatives have a laxative action, but large doses of aperient laxatives will not cause active purgation.

The onward movement of the contents of the bowels is effected by the peristaltic action of the involuntary muscular coat of the intestines. This action is excited by a bulk which the muscular rings can grip, by indigestible substances, by the bile, by irritating products from fermenting food, and by drugs which stimulate the intestinal muscles. A drug may enter the blood-vessels or lymph-vessels of the intestine and act primarily on the smooth muscular fibres or, secondarily, may affect the sympathetic nerve plexuses of Auerbach and of Meissner which enervate these muscles. Castor oil and senna have this action. Thirdly, the blood may carry the drug to the higher controlling nerve-centres, producing such stimulant effect on peristalsis as follow the use of aloes or strychnine. All the laxatives and the simpler purgatives act by increasing peristalsis only. The hastened onward movement of the contents of the intestine does not give time for the usual amount of absorption of water by the large intestine or even by the small intestine. The fæces, moistened by the gastric and intestinal secretions, remain fluid, and are passed as soft stools, though usually formed.

Any excess of fluids above the amount which is normally absorbed by the intestinal vessels renders the fæces more liquid and thus excites peristalsis. This effect is produced by drinking a glass or two of water on going to bed or half an hour before meals. It is one of the beneficial effects of a fluid diet and of certain procedures in hydrotherapy. In very warm weather, in overheated rooms, or in a dry atmosphere, the increased perspiration removes the water from the blood, intestinal secretion is diminished, absorption is increased, and the bowels are apt to become constipated, particularly in children. The same effect follows the use of very dry food. The drinking of large quantities of water or of such bland fluids as weak tea, coffee, beer, or mineral waters will promote a laxative action in such cases.

The fæces may be rendered liquid by an increased secretion from the intestinal glands. The irritating products from improperly digested or fermenting food and from retained fæces act in this way, so that constipation is apt to be followed by toxic symptoms and violent diarrhœa. A good example of this action is shown in cholera morbus. The effect of these toxic products is usually much beyond those of proper laxatives. Among the drugs which increase glandular secretion are the mercurials, especially calomel, jalap, scammony, podophyllum, oleum terebinthinæ, tobacco, elaterin, colocynth, euonymus, gamboge, guaiacum, colchicum, iridin, and corrosive sublimate. Minute doses of these will act as laxatives.

The saline purgatives and hydragogues produce watery stools by disturbing osmosis. Absorption is greatly diminished, while the demand for secreted fluids is so great that, if large amounts of fluid are not swallowed, the blood is so depleted that bodily weakness and prostration follow. Such drugs are not adapted for use as laxatives, though some of them are so used in small and frequently repeated doses. A single small dose usually irritates the intestinal glands without purging. Among such drugs are sodium sulphate, potassium bitartrate, magnesium sulphate, potassium sulphate, potassium tartrate, pulvis effervescens compositus, sodium chloride, and sodium phosphate.

The laxative effect which follows the mere addition of bulk to the fæces is well illustrated in the use of foods which contain much cellulose, such as bran and succulent vegetables. The fibrous cellulose in these substances is so nearly indigestible that it mostly passes on to the large intestine unchanged. As it does not readily ferment, the main effect is to excite peristalsis by filling the grip of the muscular rings in their vermicular movements, and to hasten the movement of the fæces. If much of such indigestible food is habitually eaten, the size of the stomach and bowel is increased, as in the herbivorous animals, and the beneficial effect is lost. In such food the cellulose fibres enmesh much starch and other digestible substances, which are thus protected from the di-

gestive fluids, but not from fermentation. Hence such coarse foods, and especially grains, should be thoroughly cooked to soften the fibres, break the cellulose capsule of the starch grains, and sterilize the food throughout. The length of time needed to cook oatmeal properly has brought into the market numerous forms of rolled, steamed, and roasted meal in a partially prepared state. The other grains have been treated by ingenious methods to render them palatable and wholesome, so that the physician now has the choice of many laxative foods and can vary the diet so as not to destroy the appetite.

The value of *fruit* as a laxative is due not only to the cellulose fibres, but also to the vegetable acids, salts, and sugars. These acids, salts, and sugars serve as food and have a slight purgative effect, especially when combined with the fibre and water of the fruit. The fruit should ripen on the tree to have the best effect. Much of that found in the market is gathered before maturity, when still hard enough to bear shipment. Such fruit should be well cooked. The small seeds of figs, strawberries, and other berries do not digest, but act as a mechanical stimulus to the coats of the intestines.

A number of the laxatives may be given by the rectum as enemata. When food is thus given, it is of course only nutrient and stimulant. The rectum and colon may be emptied by injecting an enema of warm water, warm soapsuds, or thin gruel. These excite peristalsis, which, in a reflex way, affects the parts above the rectum in a manner similar to the reflex effect upon the large and small intestines in the normal act of defecation. The laxative enemata which produce further effects are chiefly those containing castor oil, olive oil, or glycerin and the *enema aloes*, the *enema magnesii sulphatis*, and the *enema terebinthinæ.*

LEAD.—Of all the metals which exert ill effects upon the economy, this is by far the most important, on account of the extent to which it is employed in the arts. It may be introduced into the system by inhalation, through the alimentary canal, or by contact with the mucous membranes, the skin, or raw surfaces, but the symptoms of *lead poisoning* are always alike, and depend for their severity upon the amount absorbed and the length of time the individual is exposed to its influence. By far the largest number of cases occurs in white-lead factories, in which the lead, after undergoing various manipulations, is converted into a carbonate which must be ground before becoming suitable for use as a paint, and the air of the apartments in which this is done contains large amounts of the dust given off. Among house-painters and paint-mixers it is also very common. The artisans in these industries should exercise the utmost cleanliness, should avoid taking their meals in the places where they work (to do which is prohibited by law in some countries), occasional doses of magnesium sulphate should be taken, and whenever the slightest disturbance of the digestion is observed sulphuric-acid lemonade should be administered after each meal. By these latter measures the lead, if it enters the system through the alimentary canal, is rendered insoluble and but little is absorbed. The clothes which are worn when the person is at work should be changed at the end of the day, and frequent bathing indulged in. To the bath water small amounts of sulphurous acid or of potassium sulphide may be added with advantage. Printers are notoriously liable to plumbism, which is believed to be in a measure due to the habit of indulgence in alcoholics which is so common among a certain class of them. It goes without saying that smelters, shot-makers, and all who handle the fused metal are also subject to this complaint, but it is relatively less frequent among them, on account of the absence of fine particles of the metal or of its salts. In them the trouble comes principally from the inhalation of the vapour given off by the melted metal and also to a certain extent from the handling of the metal itself. Workers in pottery and glass, file-cutters, plumbers, calico-printers, gilders on wood, and those employed in any industry where lead is used are also liable to plumbism. This has occasionally been observed in cabinet-makers who make use of a glass "sand-paper," the particles of glass containing lead. Leaden weights have been largely used in "Jacquard" looms, and those tending them, being compelled to handle the weights, have been attacked.

When plumbism occurs among those known to be exposed to contact with lead or its salts its remedy lies largely in the hands of the person affected, but when the condition occurs outside of this class its recognition is not always easy or its source readily found. Probably the most common cause in these cases is the use of water contaminated in its passage through lead pipes or by its being stored in tanks lined with lead.

The purer water is and the freer from oxygen it is, the less solvent of lead is it, and consequently rain water contained in lead-lined receptacles is not often contaminated with lead. When, however, free oxygen, carbonic acid in any considerable amount, especially when under pressure, nitrates or nitrites, organic matter and the acids derived from it, are present, the danger of poisoning exists. By the action of oxygen and water a portion of the metal is converted into the fairly soluble hydrated oxide, $PbOH_2O$. This process is more active in the presence of the nitrates and nitrites. Moderate amounts of carbonic acid are quite harmless, as the resulting compound, lead hydrocarbonate, is insoluble and forms a coating upon the interior of pipes, etc., which protects them to a great extent. An excess of this acid results in the formation of the basic carbonate, which is soluble in water. For some unknown reason pressure seems to assist in the formation of this carbonate and to increase its solubility, facts which readily account for the many cases of plumbism resulting from the improper use of lead and solder in the construction of "soda-water" fountains, beer pumps, etc. Fortunately, this has been done away with to a great extent by the use of tin and iron pipes and receptacles. It has been

frequently observed that the first water drawn in the morning, or after the fountain has been unused for several hours, contains a much larger amount of lead than that drawn at other times—a fact which should suggest the drawing and rejecting of a pint or so of the water each morning. The same has been observed in beer pumps. The decomposition of organic matter gives rise to acetic and other vegetable acids and subsequent formation of soluble salts. The lead compounds of the mineral acids are insoluble and are, with the exception of the nitrate, without particular interest in this connection. Chlorides are accused of facilitating the solution of lead, and consequently brackish water and that drawn from wells in close proximity to manure piles should be kept free from contact with it. It is probable that water drawn through lead pipes in stables may contain sufficient lead to affect seriously the condition of the live stock to which it is given.

Water containing calcium carbonate or sulphate, phosphates, or silica has little or no effect upon lead, and, as nearly all public water supplies contain more or less of one or another of these bodies, there is little danger to be apprehended from the almost universal use of lead pipes for its distribution through dwellings. It will be found wise, however, to allow the water to run for several hours if the house has been vacant for a time, and to draw off sufficient each morning to thoroughly empty the entire system of house pipes. The water from cisterns lined with cement is probably but slightly plumbo-solvent, as it always contains more or less of calcium salts and is alkaline in reaction, so that there is little danger, even if lead pipes run from the cisterns.

It has been found that when a water supply is drawn from a considerable elevation it is more apt to be acid than when it is taken from lower levels, and consequently more active in attacking lead. There are some grounds to assume that there are certain micro-organisms which give an acid reaction to water that would clear up certain cases of contamination which otherwise would seem inexplicable. The introduction of lead pipes into wells is not desirable, as, although the water to begin with may have no effect upon the metal, it is probable that sooner or later sufficient organic matter will accumulate and solution of the lead take place. Wherever it seems impossible to keep water free from contact with this metal it is a wise precaution to allow it to pass over limestone or marble. If this is done it is probable that little or no danger is to be apprehended from its use.

Various substitutes have been proposed for lead in the manufacture of pipes for the conveyance of water, such as iron pipes lined with glass or porcelain, but none of them are very satisfactory, as the lining is too easily broken. When considerable volumes are to be transported, and when the pipes are kept full, nothing is so good as plain cast iron. For smaller conduits wrought-iron pipes are safe, but readily become clogged with a soft mass made up of rust and dirt. Galvanized pipes, or those thinly coated with zinc, are probably the best that can be used for house distribution. Lead pipes lined with tin offer many theoretical advantages, but there is no certainty that the lining is perfect, and if a flaw exists galvanic action is set up and the condition is worse than if plain lead had been used. No limit can be set as to the amount of lead which water may safely contain, but it should not exceed $\frac{1}{100}$ of a grain to the gallon if the water is to be used in considerable quantities or for any length of time. The presence of lead in water may be readily detected by carefully sprinkling upon the water in a transparent vessel finely powdered potassium bichromate, which will sink in the form of a yellow powder (lead chromate) if lead is present.

The use of white lead for interior painting has been severely criticised, but, aside from the slight danger of poisoning while it is being applied, it is almost entirely without objection. If a substitute is desired, zinc oxide, which is entirely unobjectionable, may be employed and will give a more dazzling white than the lead. Some persons are particularly susceptible to the smell of fresh paint, and are often affected with nausea, disturbed digestion, etc. This is largely due to the odours of the oil and turpentine, but there is no doubt that in many instances the lead is at the bottom of the trouble, for, when it is mixed with considerable turpentine, as is the rule when interiors are painted, appreciable amounts are volatilized. It is therefore prudent for all persons to avoid the use of freshly painted apartments until the paint is thoroughly dry. Water tanks and all receptacles which are to contain food and water should never be painted with white lead, and its employment upon roofs from which rain water is collected is unsafe. Paints having as their bases any of the earthy pigments or iron are entirely free from danger and just as durable. Red lead, or lead oxide, presents the same objections to its employment in paint as white lead, and what has been said will apply equally well to it. The cheaper varieties of glazed earthenware and enamelled ironware contain lead in the glazing, and their use in the household has resulted in a number of obscure cases of poisoning. The glaze upon some kinds of paper, especially that used for cheap cards, has lead as one of its constituents, and, while there is probably little danger in its use by adults, children, who are apt to acquire the habit of chewing paper, may thus become affected. Cheap enamelled cloth, especially a variety used in making baby carriages, contains lead, and cases of poisoning in infants have been reported.

The so-called "tin foil" usually consists of alternate layers of tin and of lead, the former on the outside. It is very largely used for wrapping tobacco, candies, etc., and, provided the outer layers are unbroken, little danger is to be apprehended from its use, but if one or the other of these is broken, there is a chance that poisoning may follow the use of the articles it is wrapped around, especially in the case of chewing-tobacco, which is more or less moist and contains salts, especially potassium nitrate, which promote galvanic action.

For some time after the introduction of canned fruits, etc., many cases of poisoning were found to be due to the solution of the lead of the solder used in the manufacture and sealing of the cans. At the present time the greater precautions observed by the manufacturers have caused a marked diminution in the number of these cases, but still sufficient contact with the solder exists, even in the most carefully manufactured goods, to render the accident possible if fermentation of the contents of the can occurs. As a rule, this is manifested by an outward bulging of the heads of the cans, technically known as "swelling," and all such goods should be rejected. It is a wise precaution to shake all canned goods before using them, to ascertain if there is any loose solder inside. If there is, it will be heard to rattle and will furnish a valid objection to the use of that particular can. It is fair to state that many cases of acute poisoning, manifesting itself by nausea, diarrhœa, etc., are entirely unconnected with the presence of lead, but are due to the incipient decomposition of the contents of the can.

Lead chromate, being relatively cheap and of a brilliant yellow colour, has been largely used in the manufacture of candies and confectionery, but has been abandoned except by the most unscrupulous manufacturers in favour of the harmless vegetable colours. It is well, however, to bear in mind the possibility of its occurrence in cheap candy, etc. Both the chromate and the red oxide are used to colour artificial flowers and fruits, sealing wax, and wafers, and, while the greatest danger is to the workers in these objects, there is a possibility of their falling into the hands of children.

Face powders and bleaches, hair dyes, and any cosmetics may contain lead and thereby cause plumbism. Formerly leaden combs were largely used for dyeing the hair, being drawn through it after it had been moistened with a solution of potassium sulphide. The list of substances to which lead or its salts have been intentionally added might be multiplied almost indefinitely, but it is believed that those mentioned are the ones most apt to give rise to lead poisoning, and that the others are of but slight practical importance.

The prolonged medicinal employment of the salts of lead, either internally or externally, may give rise to plumbism, but such an accident is hardly likely to occur if the smallest amount of discretion is used. It is wise, whenever lead is employed internally, to watch the gums closely and to be on the lookout for abdominal pains or constipation, and if the slightest symptoms of poisoning occur, to discontinue the use of the remedy at once. The gouty diathesis is a contra-indication to the employment of lead in any form.

Acute poisoning by lead or its salts is quite rare, the insoluble salts being without much effect, except in almost phenomenal doses, and the soluble ones being, as a rule, not very accessible. The acetate is ordinarily the cause in nearly all cases of poisoning, but not less than an ounce is necessary to produce very serious effects. The symptoms are irritation of the stomach and intestines, followed by coma and collapse in fatal cases. Vomiting of white curdy matter is not uncommon, and the stools are apt to be coloured black. The antidotes are dilute sulphuric acid, any sulphate, albumen, salt, alkalies, and soap. When only moderate amounts have been ingested, diarrhœa and disturbance of the digestion may be the only symptoms present.

The long-continued ingestion of lead or its salts almost invariably results in the condition known as *plumbism*, the symptoms of which may be very obscure and referable to lead only after the most patient investigation into the concomitant circumstances. Often there may be nothing beyond a well-marked cachexia, but ordinarily there will be colicky pains, most common near the umbilicus, relievable by pressure upon the abdomen, constipation with dark-coloured stools, and indigestion. After a while a bluish line forms along the margins of the gums, absent where the teeth are lacking, due to the deposit of lead sulphide formed from the sulphuretted hydrogen given off by the tartar on the teeth. This line, while it is rarely absent in the ordinary victim to plumbism, may be wanting in those who exercise great care of their teeth and keep them free from tartar. The liver usually becomes smaller, the intestines are contracted, and the belly is drawn in. A jaundiced appearance may exist as the result of the hepatic complication, and the urine be tinged with biliary colours. Later, albuminuria may appear, and if it previously existed is apt to be aggravated. Pains resembling those of rheumatism occur in various parts of the body, and are usually aggravated by motion and by damp weather. Arthralgia is a common complication, and is undoubtedly due to the deposit of urates in and around the joints. It is possible that many attacks of gout are due to lead poisoning. It is very certain that lead, even when used medicinally, will bring on an acute attack of gout in a person predisposed to it, and that in many cases in which there has been no reason to suspect poisoning the characteristic blue line upon the gums has been observed. The most marked sign of plumbism is a paralysis of the extensor muscles of one or both hands, usually unaccompanied by loss of sensation. This paralysis may be distinguished from that due to disease or injury of the musculo-spiral nerve by the fact that the supinator longus is never affected. Paralysis of other muscles may occur, and wasting, especially of those of the ball of the thumb, is sometimes observed. Bilateral symmetrical anæsthesia is often seen, and usually is found upon the neck, chest, and arms. Headache, vertigo delirium, convulsions, or coma may exist, but they are not of very frequent occurrence. The prognosis as to life is usually good, as it is the exception when the cause of the condition is not recognised, but often the results are lasting, especially when paralysis has been one of the symptoms. Death, when it occurs, may be due to a fatal cachexia, paralysis of the muscles of respiration, cerebral trouble, or cirrhosis of the liver or kidneys. The mainstay in the

treatment is iodine in one shape or another, but to be effectual it must be given in large doses and for a considerable length of time. Frequent doses of Epsom salt are of assistance, as it not only relieves the colic but renders insoluble any lead which may be in the alimentary canal. Tonics and a generous diet are adjuvants which are not to be neglected. The paralysis must be treated by electricity, the induced current being employed, provided the affected muscles react. If they do not, the constant current must be used until reaction to the induced is obtained. When no reaction to the constant current can be elicited, it is usually the case that the paralysis is never recovered from. Whatever measures are adopted, the removal of the person from the influence of the metal is imperative.

Lead Acetate.—By far the most valuable salt of this metal, and the only one of any practical value for internal administration, is the acetate, the *plumbi acetas* of the U. S. and Br. Ph's., the *plumbum aceticum* of the Ger. Ph., or sugar of lead. Its most important action is that of an astringent, and it may be given with advantage in nearly all forms of *diarrhœa*, especially that of phthisis. It is rather more effective when combined with opium. In *hæmorrhages from the stomach* and *intestines* it is probably as useful as any hæmostatic, so far as its local action goes, and, in addition, slows the action of the heart in very much the same manner as digitalis does. This latter property renders it of value in all forms of hæmorrhage. For *hæmoptysis* it may be well to combine opium with it to quiet the cough which is so apt to prolong the hæmorrhage.

Ointment of acetate of lead, *unguentum plumbi acetatis* (Br. Ph.), contains 2 parts of lead acetate and 73 of benzoated lard, and is used for the same purposes as the cerate of lead subacetate. Somewhat similar is the *unguentum glycerini plumbi subacetatis* (Br. Ph.). The *glycerinum plumbi subacetatis* (Br. Ph.) is another substitute for the cerate, but is rather harsher in its action. The pill of lead and opium, *pilula plumbi cum opio* (Br. Ph.), contains in each grain ⅛ of a grain of opium and ¾ of a grain of lead acetate. It is used principally in the treatment of *diarrhœa*. Compound lead suppositories, *suppositoria plumbi composita* (Br. Ph.), contain 3 grains of lead acetate and 1 grain of opium. They are astringent and sedative, and are very useful in the treatment of *dysentery* and *irritable conditions of the rectum*.

The unofficial lead-and-opium wash, *lotio plumbi et opii*, consists of 2 drachms of lead acetate, ½ fl. oz. of laudanum, and enough water to make 16 fl. oz. It is very largely used as a sedative application in *erysipelas*, *bruises*, and all *painful and irritable surfaces*. It is also useful in relieving the itching of the eruption caused by *poison ivy* or *oak*. It must be well shaken before being used, and is ordinarily applied by soaking a cloth in it, which is laid upon the affected surface.

Under no circumstances should lead salts enter into the composition of collyria, as, if abrasions of the cornea exist, black deposits of lead are almost sure to occur.

Goulard's extract, or solution of lead subacetate, *liquor plumbi subacetatis* (U. S. Ph., Br. Ph.), *liquor plumbi subacetici* (Ger. Ph.), is an aqueous solution of the basic acetate of lead prepared by adding a suitable amount of lead oxide to a solution of the acetate, but is unsuitable for use unless diluted by at least double its bulk of water. It has the same general effects as the salt constituting its base, but is never employed internally. It forms a very desirable preparation to apply to *inflamed surfaces*, *sprains*, *bruises*, *blisters*, *scalds*, *excoriations*, and *fissured nipples*, or in any condition in which a mild astringent and sedative action is desired. Lead water, or diluted solution of lead subacetate, *liquor plumbi subacetatis dilutus* (U. S. Ph., Br. Ph.), is simply the same solution, diluted with about thirty times its bulk of water. From the first-named solution is made a cerate, *ceratum plumbi subacetatis* (U. S. Ph.), by incorporating with it four times its weight of camphor cerate. It is a very useful application to *raw surfaces*, *chilblains*, etc.

[A *lead liniment*, consisting of 10 parts each of powdered talc and starch, 4 of glycerin, and 20 of liquor plumbi subacetatis dilutus, has been highly recommended by Professor Boeck, of Christiania (*Mntsh. f. prakt. Dermat.*, Aug. 1, 1895; *Edinb. Med. Jour.*, Dec., 1895), in the treatment of various *inflammatory skin diseases* attended with dryness and severe *itching*. If, he says, the liniment, as sometimes occurs with very sensitive skins, gives rise to slight burning, half of the solution of lead may be replaced by an equal amount of a 1-per-cent. solution of boric acid. When the liniment is used, after being well shaken, it should be diluted with sufficient cold water, usually twice its bulk. It should then be painted or sopped on to the affected skin. The surface is allowed to remain uncovered for a few minutes, till the thin layer has had time to dry. The patient can then either bandage the part or, if at night, may go to bed, and for at least half an hour experiences a pleasantly cool sensation, which almost annuls even the severest itching. The application may be repeated as often as necessary; its action is that of a cooling lotion which gently powders, and at the same time is astringent and antiseptic. In acute, papular, rapidly spreading *eczemas* it produces immediate amelioration, even quickly cures. It must not be employed for vesicular, weeping, or crusted forms, since such are only aggravated by it. In certain chronic dry eczemas, such as those widespread and troublesome kinds met with in old persons, it commonly leads to improvement, and if its use is continued long enough, may cause their disappearance. By its lessening the tendency to scratch, too, pustules and boils are rendered less apt to appear. Boeck has found it particularly useful in *eczema of the anus* and *of the genitals*. It proves of much service also in *lichen planus*, and in diffuse, inflamed cases of *psoriasis*.]

Lead carbonate, *plumbi carbonas* (U. S. Ph., Br. Ph.), *cerussa* (Ger. Ph.), acts as a mild

astringent and sedative to *raw surfaces*, such as those of *burns*. It is never used internally. It may be prepared for use by combining it extemporaneously with any unctuous substance, or the ordinary painters' white lead of commerce may be used. A more elegant preparation is the *unguentum plumbi carbonatis* (U. S. Ph.. Br. Ph.), *unguentum cerussæ* (Ger. Ph.). The chief use of these preparations is in the treatment of *burns, scalds*, and *excoriations*, and unless very extensive surfaces are treated it is rarely that any ill results follow their use. A very ready application to burns is ordinary white paint, which, however, should consist of white lead and linseed or cotton-seed oil only, and not contain turpentine, or "drier." The *emplastrum cerussæ* of the Ger. Ph. consists of 7 parts of lead carbonate, 2 of olive oil, and 12 of lead plaster.

Lead iodide, *plumbi iodidum* (U. S. Ph., Br. Ph.), has been substituted for the other iodides, but is entirely unsuitable for internal use, as there is considerable danger of plumbism occurring. It may be given in doses of from 1 to 3 grains every two or three hours, but, if its employment is to be protracted, it is wise to be on the lookout for symptoms of poisoning. An ointment, *unguentum plumbi iodidi* (U. S. Ph., Br. Ph.), contains about 1 part of the salt in 10. It is used with fairly good results, provided it is not carried too far, in the treatment of *enlarged glands* and *hypertrophy of the spleen*. The iodide-of-lead plaster, *emplastrum plumbi iodidi* (Br. Ph.), contains about the same amount of the salt as the ointment does, and is a rather more elegant preparation.

Lead nitrate, *plumbi nitras* (U. S. Ph., Br. Ph.), is rarely, if ever, employed internally, the acetate being more appropriate when the constitutional effects of lead are desired. It may be used to advantage, however, in solutions of the strength of ten per cent., in the treatment of *fissured nipples, chapped lips*, and similar conditions. The powdered salt is sometimes applied to *unhealthy ulcerations*, and for *onychia* it is alleged by some to be almost a specific. As it decomposes sulphides, it may be used as a deodorizer when such bodies exist, but it is in no sense of the word either a disinfectant or a germicide. Ledoyen's disinfecting fluid is simply a solution of 1 drachm of this salt in 1 oz. of water.

Lead oxide, *plumbi oxidum* (U. S. Ph., Br. Ph.), *lithargyrum* (Ger. Ph.), litharge, is the purified commercial red oxide of lead subjected to heat until it is semi-vitrified. It is never used by itself, but enters into the composition of various plasters, and is employed for making other salts of lead.

Lead plaster, or *diachylon plaster*, *emplastrum plumbi* (U. S. Ph., Br. Ph.), *emplastrum lithargyri* (Ger. Ph.), is prepared from olive oil and lead oxide. It is an oleate of lead plus glycerin and some unimportant minor constituents, and is principally used as a basis for other plasters, but may be employed when a simple protective plaster for *raw* or *excoriated surfaces* is desired. It may be obtained in rolls, and may be spread upon cloth, etc., as it is needed. The *emplastrum lithargyri compositum* of the Ger. Ph. contains, in addition, ammoniacum, galbanum, and turpentine, and is employed as a stimulant of the parts to which it is applied.

Diachylon ointment, *unguentum diachylon* (U. S. Ph.), is the plain ointment diluted to one half its strength with olive oil and oil of lavender flowers. It is used largely in the treatment of *eczema*.

Lead saccharate has been used as an injection into the bladder to dissolve calculi, but is of no great value.

Lead tannate, which may be prepared by adding a solution of lead acetate to one of tannin, and separating the precipitate by filtration, may be used, alone or incorporated with some fat, as an application to *bedsores* and other *unhealthy ulcers*.—Russell H. Nevins.

LEECHING is the local abstraction of blood by means of the leech, *hirudo* (Br. Ph.). In Germany leeches are official as *hirudines* (Ger. Ph.). The speckled leech, *Sanguisuga medicinalis*, alone is recognised by the Ger. Ph., while the Br. Ph. recognises both *Sanguisuga medicinalis* and *Sanguisuga officinalis*, the green leech. The animal of either variety is wormlike, with a soft, smooth body, transversely wrinkled. Its length is in the neighbourhood of two or three inches, it tapers toward each end, and it is convex upon one side and flattened on the other. The back is of an olive colour and longitudinally marked with rust-coloured stripes. The belly of the speckled leech is greenish-yellow, spotted with black; that of the green leech is olive-green. The leech is an inhabitant of marshy ground and small streams. The American leech, *Hirudo decora*, is less esteemed than the European varieties, because as a rule it abstracts a smaller quantity of blood. Its back is of a deep green colour and longitudinally marked with rows of spots of which the lateral rows are black, while the central row is brownish-yellow. The belly is yellowish and is irregularly spotted with black. The amount of blood which a leech will draw varies with the variety of the animal and its condition, as well as with the vascularity of the part to which it is applied. The quantity ranges between 1 and 4 fl. drachms and occasionally exceeds the latter amount, but it not infrequently happens that bleeding continues after the withdrawal of the leech, and that thus the amount is augmented. This continued bleeding is said to be due to a liquid which the animal secretes and which prevents coagulation of the blood.

The practice of leeching is of great antiquity, and, though less employed than formerly, it is frequently used and should be yet more. It is the least painful means of locally abstracting blood, and has the advantage of an applicability to parts which cupping can not reach or which, when inflamed, are too sensitive for the manipulations which cupping entails. On the other hand, it can not be denied that the leech is repulsive, and the repugnance of the patient may even forbid its use. It is of much value for *local depletion* in children.

The area to which the leeches are to be applied should be thoroughly cleansed with soap and water and afterward rinsed in water alone. If hair is present it should previously have been removed. It may then be sufficient to place the leech upon the chosen spot and allow it to draw until filled. It is often necessary, however, to incite the animal to its work as well as to control it when once it is employed, for the leech, in spite of its lack of beauty, is apt to be fastidious and headstrong as well. To induce the leech to draw blood in case it does not appear eager to do so, it is often well to place a drop of milk upon the part or a drop of blood taken either from the patient or from another or obtained by slightly pricking or scratching the part until blood appears. This milk or blood attracts the leech and appears to have an appetizing effect upon it, and the natural result is that, having tasted food and desiring more, it takes the most natural way to get it. The avidity of the leech is also said to be increased by its previous brief immersion in cold water, and it has also been recommended to prepare the part for its delectation by previously reddening it by a sinapism. This procedure has the additional advantage of causing a greater removal of blood from the part, for it is well known that from vascular regions leeches will withdraw more blood than from those which are dense and firm. This previous reddening is, of course, not demanded in case the leech is to be directly applied to inflamed situations, for the local condition in this case is already one of hyperæmia.

To direct and limit the action of the leech it is well to use a glass tube, or leech glass, in which the animal is placed, and by which its head is directed to the area it is desired to deplete. It is a simple matter then to manipulate the leech and, when its blood-drawing has begun, to gently remove the tube, leaving the leech undisturbed. Another means by which the sucking of the leech may be directed and limited is to cut a small hole in a piece of blotting-paper, then to moisten it and place it upon the skin so that the hole shall cover the site chosen for bleeding. The leech under these conditions can draw blood only from the portion of skin which is uncovered. The leech will ordinarily continue to draw blood until it is filled, and then it will drop off, but if for any reason it is desired to terminate its operations before that time a drop of water may be placed upon its head or, if that hint is insufficient, salt water or a small amount of common salt placed upon it will always induce it to end its meal. If, on the other hand, the bleeding has been insufficient, the application of warmth to the wound, particularly by a poultice, will serve to continue the bleeding and increase the depletion.

It is not uncommon for the bleeding from leech bites to continue without aid, and even obstinately and in spite of efforts to stop it. To control the hæmorrhage in such cases—and, particularly in children, this bleeding may be momentous—the wound should be exposed to the air, but if clotting does not then occur, pressure may be used upon it or, if the part is a soft one, pinching. This failing, a styptic application may be made of alum, tannin, nitrate-of-silver stick, or collodion. Exceptionally, these too will fail, and then the wound should be sutured.

So far as the number of leeches to be employed is concerned, that will vary with the circumstances of the case and the variety of the leech. In the United States five or six leeches may be expected to remove about 1 fl. oz. of blood. Embarrassing accidents have happened from the migratory tendencies of the animals, and therefore caution must be had not to apply them too near a bodily orifice, and to see by actual count that every leech which is applied is subsequently removed. If by chance one of them should be swallowed, salt water or port wine should be freely given and followed if necessary by an emetic. If the leech has entered the rectum, the port or the salt water should be given in an enema. It is quite possible to use a leech more than once, for it may be made to disgorge the blood it has swallowed by drawing it, tail first, between the fingers, which act to empty it by pressure. If then the leech is placed in clean water which is frequently changed, it soon becomes serviceable again. Other procedures are made use of for this purpose, but these, as well as the healthful preservation of leeches, concern the pharmacist rather than the physician.

The therapeutics of leeching is the local abstraction of blood, but a *derivative* action is sometimes elicited by it as well, and it may appear more beneficial even than general blood-letting. Local depletion, however, is its main application. *Meningitis* may be benefited by leeching from the temples or nucha, *conjunctivitis* by leeching from the temple, *otitis* by leeching from the mastoid area, and *orchitis* by leeching from the perinæum. *Inflamed joints*, too, may receive benefit by leeching, and the procedure is applicable to a number of similar *engorgements* and *inflammations*. In general, parts of the body which are of loose structure should be avoided in leeching, especially the eyelids and the scrotum.

Henry A. Griffin.

LEMON.—As the general therapeutic effects of this fruit depend almost exclusively upon the citric acid contained in it, the reader is referred to the article on that substance. Oil of lemon, *oleum limonis* (U. S. Ph., Br. Ph.), *oleum citri* (Ger. Ph.), is the volatile oil obtained from fresh lemon peel. It is used solely as a flavouring and in the preparation of essence of lemon, *spiritus limonis* (U. S. Ph.), which is simply an alcoholic solution of the oil flavoured with the fresh peel. This is suitable for combining with mixtures, and may also be employed in the household in place of the cheaper and less reliable preparations of the shops. Lemon peel, *limonis cortex* (U. S. Ph., Br. Ph.), *cortex citri fructus* (Ger. Ph.), is directed to be used in its fresh state in the U. S. and Br. Ph's, and dry in the Ger. Ph. It constitutes the base of several flavouring preparations, and is the source of the oil. The juice of the fresh fruit is recognised by the U. S.

and Br. Ph's. under the name of *limonis succus*. It is used in the extemporaneous preparation of various effervescing drinks, and, combined with sugar, forms the *syrupus limonis* of the Br. Ph., which is used for making lemonade, etc. The tincture of lemon peel, *tinctura limonis* (Br. Ph.), is made from the fresh peel. Although slightly aromatic, it is rarely used except to disguise the taste of unpleasant mixtures.

Lemon-juice forms the base of nearly all drinks in which a mild diuretic and diaphoretic action is desired, and is employed in the preparation of a host of cooling beverages included under the generic name of lemonade. It is entirely unobjectionable save in the uric-acid diathesis, in which it may increase the amount of free uric acid in the urine and set up more or less irritation of the bladder and urethra. When employed in illness, too large amounts are to be avoided, as there is danger of disturbing the digestion, and in very young children it is well to avoid its use near bed-time, as the secretion of urine is almost always increased, and wetting of the bed may follow. It is also advisable to use as little sugar as possible, as undue amounts are easily taken when its taste is disguised by that of the juice. Carbonated waters, such as Apollinaris, Selters, and many other table waters, are, as a rule, better relished than plain water in the preparation of this class of drinks, and are generally to be preferred in sickness. It is well to avoid the cheaper metal lemon-squeezers, as they are apt to be affected by the citric acid of the juice and impart an unpleasant taste to it. Those of wood, glass, or enamelled metal are easily obtained and are free from objection. The juice may be preserved for a considerable length of time by straining it through fine cloth and raising it in glass vessels to the boiling point, or, in other words canning it just as fruits, etc., are canned. Prepared in this way, it loses none of its therapeutic value, but is destitute of the agreeable flavour of that freshly expressed. The juice of the fresh lime is objectionable to some on account of a peculiar musty taste, but it may be substituted for that of the lemon with entire propriety. It or lemon-juice is of undoubted value in the treatment of *jaundice* not dependent upon anatomical changes in the hepatic tissue, and in the mild variety which is often epidemic in hot climates it may usually be depended upon to effect a cure if taken in large amounts. A tumblerful of hot lemonade, which may be flavoured by the addition of a small piece of the peel, is one of a great number of preparations taken for breaking up a *cold*, just before going to bed. It is usually efficacious in arousing profuse diaphoresis.

[Lemon-juice, taken *ad libitum*, is reputed to have the power of restraining the maniacal and other unpleasant symptoms of *poisoning with Indian hemp.*] Cf. Citric acid.

Russell H. Nevins.

LEONTODON.—See Taraxacum.

LEPTANDRA (U. S. Ph.), Culver's root, is the rhizome and roots of *Veronica virginica*, an herbaceous perennial plant of the *Scrophularineæ* that grows throughout the United States east of the Mississippi River. The rhizome and rootlets contain a volatile oil, mannite, resin, a glucoside (leptandrin), etc. A resinous matter that may be obtained by precipitation from the tincture on adding alcohol is erroneously called leptandrin, and is sold under that name.

Leptandra is a *cathartic*, and in large doses an *emetic*. Rutherford's investigations showed that it had but feeble cholagogue properties. It has been recommended as a tonic in *dyspepsia* in which there is deficiency of the gastric juice, and in *constipation*. The cathartic dose of the powder is from 20 to 60 grains. The extract, *extractum leptandræ* (U. S. Ph.), is used in doses of from 2 to 10 grains. The fluid extract, *extractum leptandræ fluidum* (U. S. Ph.), may be given in doses of from 20 to 60 minims. The dose of leptandrin is from 0·15 to 0·77 of a grain.

Samuel T. Armstrong.

LETTUCE.—See Lactuca and Lactucarium.

LEVISTICUM.—See Ligusticum.

LICHEN.—See Cetraria.

LICORICE, or *liquorice*, *glycyrrhiza* (U. S. Ph.), *glycyrrhizæ radix* (Br. Ph.), *radix liquiritiæ* (Ger. Ph.), is the root of *Glycyrrhiza glabra*, a native of southern Europe, Syria, and Persia and cultivated in several of the northern countries of Europe. A species, *Glycyrrhiza lepidota*, is indigenous in this country and is found along the banks of the Missouri River; it is a good substitute for the imported root, as analysis has shown that it contains 6·3 per cent. of glycyrrhizin, while imported licorice root contains but 7·1 per cent. of that substance.

The bitterest licorice comes from Russia, the sweetest from Italy. The powdered root may be administered internally in doses of from 5 to 30 grains. The root contains an amorphous, bitter-sweet glucoside, *glycyrrhizin*, $C_{24}H_{36}O_9$, a crystallizable principle, *asparagin*, which was called *agedoite* by Robiquet, who first isolated it, resin, starch, albumin, lignin, calcium and magnesium salts, and malic, phosphoric, and sulphuric acids. If the glucoside glycyrrhizin is boiled with dilute acids, it breaks up into sugar and a bitter, brownish-yellow substance, *glycyrrhetin*.

Powdered licorice is used to prevent pills from adhering to each other, and as a dusting powder in pharmaceutical procedures. The aromatic glycyrrhizin is used to disguise the bitter taste of quinine, in the proportion of two to one. The extract is used to conceal the taste of various unpleasant remedies.

Licorice is *demulcent*, *laxative*, and slightly *stimulating to the mucous membranes*. For *bronchial catarrh* or *bronchitis* a decoction may be used, made by boiling 1 oz. of the bruised root in 1 pint of water, and the action of the licorice may be furthered by the addition of flaxseed, as in the compound infusion of flaxseed, *infusum lini compositum*, formerly official, which was made by boiling 2 drachms

of bruised licorice root and 4 drachms of flaxseed in 1 pint of water. The latter preparation is useful in *diarrhœa.* In various forms of *pharyngitis* and *laryngitis*, especially those associated with an irritable cough, Wistar's cough lozenges, *trochisci glycyrrhizæ et opii* (U. S. Ph.), each of which contains 2 grains of extract of licorice and $\frac{1}{20}$ of a grain of extract of opium, with anise oil, acacia, and sugar, are useful to relieve the irritability; one every hour or two is sufficient for an adult. A most useful and deservedly popular combination of licorice that is used in the treatment of simple *bronchitis* is the brown mixture, *mistura glycyrrhizæ composita* (U. S. Ph.), which is made with 3 parts of pure extract of licorice, 12 of paregoric, 6 of wine of antimony, 3 each of spirit of nitrous ether, acacia, and sugar, and 70 of water; the dose is from 1 to 4 fl. drachms. For *constipation* in children, pregnant women, and old persons a useful remedy is the compound licorice powder, *pulvis glycyrrhizæ compositus* (U. S. Ph., Br. Ph.), *pulvis liquiritiæ compositus* (Ger. Ph.), which contains 16 parts of powdered licorice root, 18 of senna, 8 each of fennel and washed sulphur, and 50 of sugar; the dose is from $\frac{1}{2}$ to 2 drachms, given at bed-time.

[Commercial extract of licorice, stick licorice, black licorice, is the *extractum glycyrrhizæ* of the U. S. Ph. and practically the equivalent of the *succus liquiritiæ* of the Ger. Ph., which is licorice-juice boiled down to one quarter of its bulk. The purified extract, *extractum glycyrrhizæ purum* (U. S. Ph.), *extractum glycyrrhizæ* (Br. Ph.), *succus liquiritiæ depuratus* (Ger. Ph.), differs somewhat according to the directions of the various pharmacopœias. It may be given in doses of from 5 to 60 grains. The dose of the fluid extract, *extractum glycyrrhizæ fluidum* (U. S. Ph.), *extractum glycyrrhizæ liquidum* (Br. Ph.), is 1 fl. drachm. Syrup of licorice, *sirupus liquiritiæ* (Ger. Ph.), *syrupus glycyrrhizæ* (Nat. Form.), may be given in teaspoonful doses, as may also Ringelmann's elixir, *elixir e succo liquiritiæ* (Ger. Ph.), which contains fennel water and anisated ammonia water, and is used as a stimulant *expectorant.*] See also GLYCYRRHIZINUM AMMONIATUM (page 451).—SAMUEL T. ARMSTRONG.

LIGNOSULPHITE. — Under the name *Lignosulfit*, v. Löwenthon (*Pharm. Ctrlh.*, 1895; *Am. Med.-surg. Bull.*, Sept. 1, 1895) describes a liquid obtained as a side-product in the manufacture of cellulose, and says it is employed in some portions of Europe as a remedy against various diseases of the respiratory organs, especially *pulmonary tuberculosis.* It is used as an inhalation by making it trickle over some needle-trees, such as firs, situated in a room, whereby it is vapourized in the air inhaled by the patients, who are made to sojourn in this room for a few hours every day. A small apparatus is also made which enables patients who can not go to a sanitarium to receive the treatment at home, in an ordinary room. The active principle is said to be sulphurous acid, its irritating and dangerous properties being modified by the presence of aromatic and volatile substances.

LIGUSTICUM, *radix levistici* (Ger. Ph.), lovage, is an unimportant drug consisting of the root of *Levisticum officinale*, or *Ligusticum* (or *Angelica*) *Levisticum*, a native of southern Europe, to which its use is almost entirely limited. It possesses *carminative, diuretic*, and *emmenagogue* properties, and is used in *flatulence, dropsy*, and *amenorrhœa.* Its virtues depend upon an essential oil, which, however, is not used by itself. An infusion of an ounce in a pint of water may be given in doses of 2 fl. drachms, repeated as frequently as required. All parts of the plant possess the same properties as the root, but the latter is the only portion employed in medicine. An American species, *Ligusticum actæifolium*, has similar virtues to those of the official species, but its use is very limited and confined to the regions to which it is indigenous.

RUSSELL H. NEVINS.

LILY OF THE VALLEY.—See CONVALLARIA.

LIME, *calx* (U. S. Ph., Br. Ph.), *calcaria usta* (Ger. Ph.), and *chalk* (*q. v.*, also CALCIUM and CALX), are respectively calcium oxide, CaO, and calcium carbonate, $CaCO_3$, the latter being found in the native forms chalk, marble, limestone, oyster shells, etc. These are converted into lime by heating to full redness (calcination), by which the carbonic acid is driven off and the oxide left behind, the latter being known as burnt lime or "quicklime." This, by the addition of from $\frac{1}{2}$ to $\frac{3}{4}$ of its weight of water, undergoes the process of "slaking," whereby it evolves a high degree of heat and combines with one molecule of H_2O to form calcium hydrate, $Ca(HO)_2$, or slaked lime.

Lime is one of the four alkaline earths, the three others being baryta, strontia, and magnesia. In its own form, however, it is never found, though in combination with various acids it occurs in all the three kingdoms of Nature, its base, the metal calcium, being a very widely distributed element, forming the base of all calcareous and cretaceous substances. Besides the forms mentioned above, it occurs as a sulphate (gypsum), also as a phosphate in bones, shells, and various organic tissues, and as a silicate and a fluoride in certain minerals and vegetables. Lime is soluble in about 750 parts of water and in 1,300 of boiling water; it is insoluble in alcohol. It is more soluble in cold water than in hot, changes vegetable blues to green, and forms with oils an imperfect soap. It is never used internally except in solution, for which see below.

Slaked lime, $Ca(HO)_2$, *calcii hydras* (Br. Ph.), is prepared by pouring 1 pint of water over 2 pounds of lime in a metal pot, and should be kept excluded from the air. It is soluble sparingly in water, 11 grains in a pint, less so in hot water, but its solubility is greatly increased by the addition of sugar.

Limewater, *liquor calcis* (U. S. Ph., Br. Ph.), *aqua calcaria* (Ger. Ph.), is a saturated aqueous solution of calcium hydrate, containing about 0·17 per cent. thereof at 59° F., and less at higher temperatures. It is a clear,

colourless, odourless liquid, of saline and feebly caustic taste and alkaline reaction. The dose is from 1 to 4 fl. oz.

Syrup of lime, *syrupus calcis* (U. S. Ph.), contains 6½ parts of lime, 40 of sugar, and enough water to make 100. The corresponding preparation of the Br. Ph., *liquor calcis saccharatus*, contains 1 part of lime, 2 parts of sugar, and 20 of distilled water (7·11 grains of lime to the fl. oz.). The dose is from 15 to 60 minims.

Lime liniment, *linimentum calcis* (U. S. Ph., Br. Ph.), Carron oil, consists of equal parts of limewater and linseed oil mixed by agitation. It is for local use.

Physiological Action.—Lime in the unslaked form (quicklime) has a great affinity for water, readily combines with sulphur, and thereby decomposes and destroys organic matter. Upon the living skin its action is *irritant* and superficially *caustic*, but on the mucous membranes it is more severe, and if swallowed or inhaled it may produce dangerous local inflammation followed by ulceration. In weak solution it has an *astringent* and *sedative* effect, both locally and internally, and acts as an *absorbent* and *antacid.* Chalk possesses the astringent and antacid properties of lime without its irritant qualities; the preparations of each are feebly antacid and astringent, they neutralize the acid of the gastric juice, and are sedative to the gastric mucous membrane. A minute quantity passes into the blood and promotes constructive metamorphosis, but if these substances are used in large quantity or for too long a time they will increase tissue waste. Special virtues have been ascribed to calcium carbonates derived from the animal kingdom, most of which were fanciful; yet some authorities still hold that the animal carbonates derange the stomach less than the mineral ones, and are therefore to be preferred for children and delicate persons generally.

Calcium salts play an important part in the system, as is seen in most of the functions of the body. The heart or any other muscle devoid of calcium will no longer contract. These salts have a remarkable influence upon the nutrition of plants and animals, the phosphate being especially efficient, even essential to the nourishment of the organs of locomotion—namely, cartilage, bone, tendon, and muscle, to which it bears the same relation as iron does to the blood or phosphorus to the nerve tissue. The absence of calcium salts results in emaciation and death, their deficiency in various degrees of lymphatic and osseous disease. Water without these salts is flat and insipid to the taste, but if they are present in drinking water in excess (above 20 grains of the carbonate to the gallon) the water is believed by many observers to be one of the factors producing goître. The sulphate in potable water, even in so small a proportion as from 6 to 20 grains to the gallon, is unwholesome, being apt to irritate the bowels and cause constipation and diarrhœa alternately, according as its astringent or its irritant effects predominate. Calcium salts are excreted almost entirely by the bowel, a very small portion only being absorbed; and as but little passes out by the kidneys, they have no very marked influence upon the urine.

Toxicology and Incompatibility.—All acids, all acidulous, ammoniacal, and metallic salts, especially tartar emetic, borates, alkaline carbonates, and astringent vegetable infusions, are incompatible with lime; and the preparations of lime and chalk are incompatible with acids and metallic salts, especially sulphates. In poisoning by caustic lime the antidote is a dilute vegetable acid, or lemon-juice, or carbonated water freely, followed by demulcents or fixed oils to protect the mucous membranes, and opium or alcohol as antagonists to vital depression. Poisoning by calcium chloride is treated with albumen in some form (eggs, milk, flour), mucilaginous drinks, and oils, but no acids should be used. Lime salts and potassium salts are said to be mutually antagonistic physiologically. The syrup of lime is an antidote to carbolic and oxalic acids, and lime in any form (wall plaster, etc.), and chalk (whiting, etc.), are antidotal to the mineral acids, especially oxalic acid and the acid oxalates, which they neutralize and convert into the insoluble calcium oxalate.

Therapeutics.—Lime may be used externally as a *caustic* and *depilatory*, but is rarely so employed, except in the form of *potassa cum calce.* It is a most efficient agent for hastening decomposition, which it does by its affinity for water, the resulting hydrate absorbing many of the decomposition products. Limewater is usefully employed as an enema and vaginal wash against *threadworms*, as a mouth wash for *aphthæ*, and as a lotion for *cracked nipples* and *eczematous surfaces*, also in many *mucous* and *purulent discharges.* For such purposes it may be mixed with oils or glycerin, and if a few drops of carbolic acid are added the efficacy of the mixture is increased. The liniment is such a mixture, and is best known by the name Carron oil, from the foundries at Carron, where it was extensively used. It is one of the best applications for *burns* and *scalds*, also as a dressing to the face in *small-pox*, and for cases of *eczema* affecting a large area of skin. The vapour of slaking lime and limewater as a spray are very serviceable when inhaled in *diphtheria.* Limewater, internally, is a favourite remedy for *vomiting*, especially in children, for whom it is commonly added to milk to increase the digestibility thereof, the mixture being often retained and digested when no other food can be borne. It is also an efficient *antacid* and astringent in *acid dyspepsia*, *mucous enteritis*, and *typhoid fever.* The syrup contains more lime in solution than limewater does, and may be used instead of the latter when a stronger preparation is desired, as in *poisoning by carbolic* or *oxalic acid*, etc. As a rule, limewater is best adapted for the stomach, as chalk preparations are for the intestinal canal.

Lime has an ancient reputation as a remedy for *stone in the bladder.* In 1739 Mrs. Johanna Stephens obtained from the British Parliament the sum of £5,000 as a reward for her lithon-

triptic remedy, consisting of calcined egg-shells, soap, and various aromatic bitters, the efficacy of which was certified by several prominent persons. This compound being very nauseous, limewater was suggested as a substitute by Whytt, and proved efficient in many cases, particularly when injected into the bladder. It acted, doubtless, by virtue of its astringent and alkaline qualities, allaying the inflammation of the vesical mucous membrane, blunting its sensibility, and preventing the further growth of a calculus by neutralizing the free acid of the urine, though it certainly does not possess the solvent power alleged by its advocates.—Samuel O. L. Potter.

LINIMENTS, *linimenta* (Ger. Ph.), embrocations, are liquid preparations designed for external application to the body, generally by rubbing. Their applicability by friction is due to the oily constituents which, as a rule, they possess, and in the absence of an oily or saponaceous character they are more suited for painting on than for inunction. The rubbing is a very important factor in the use of liniments, and in the larger number of instances is really of more value than the character of the liniment itself, for massage, as everybody knows, is of untold benefit in the very class of cases in which liniments have their most frequent employment. Many liniments contain alcohol, and therein lies another element of their efficiency, for the local stimulant action of alcohol is well known. Yet the medicinal ingredients of liniments are certainly of much importance, and generally because they are rubefacient or anodyne. Of the stimulating and rubefacient drugs which are oftenest incorporated in liniments are oil of turpentine, iodine, camphor, croton oil, and ammonia water, while the anodyne liniments generally contain belladonna or chloroform, and sometimes opium. Some liniments have a resolvent and alterative action apart from their counter-irritant properties, and the liniment of mercury, *linimentum hydrargyri* (Br. Ph.), as well as the liniment of iodine, *linimentum iodi* (Br. Ph.), is rather more discutient than is accountable for by mere local stimulation. One official liniment at least is intended rather as a mechanical protective than anything else, and is seldom applied with friction. This is the well-known carron oil, or lime liniment, *linimentum calcis* (U. S. Ph., Br. Ph.), which is so commonly employed as an application to recent burns and scalds. The turpentine liniment of the U. S. Ph. is sometimes used for the same purpose.

The therapeutical usefulness of liniments in general is to produce counter-irritation and rubefaction or local sedation; sometimes the action is a combination of both these. The cases most commonly treated with them are *painful* and *inflammatory affections* which are chronic in their nature and unaccompanied by actively congestive or inflammatory manifestations, unless, as is the case in *acute bronchitis* and similar conditions, the inflammation is deeply seated. Thus *sprains* are benefited, and *bruises*, as well as vague *gouty* and *rheumatic pains*, which are as often muscular as articular. The choice of the liniment in these cases will vary with the severity of the pain, for, as almost every liniment is to some degree counter-irritant by virtue of the rubbing with which it is applied, the only question which arises for settlement is as to whether the medicinal ingredient shall render the application yet more stimulant and irritating, or whether the pain is such as to require the application to be anodyne. Besides the ailments named, stimulating liniments are applicable in cases of *laryngeal* and *bronchial inflammation* when acute, for it is unreasonable to suppose that they can have an appreciable effect upon the organic changes which mark these inflammations when chronic. That counter-irritation and analgesia are often urgently demanded need not be said, and liniments afford one means by which they may be provided, but whether liniments are to be preferred to poultices, sinapisms, plasters, stupes, ointments, vesicants, and other counter-irritant applications must be determined by the features of the case. In general, it may be said that liniments are most applicable where intermittent motion and mechanical excitation are most useful; in short, where massage might be indicated. In using liniments, especially those which are actively rubefacient, it should be seen to that subsequent exposure of the reddened area is not permitted, lest the injurious action of cold occur; and, generally speaking, liniments should not be employed where the skin is not intact, for otherwise an irritant liniment may cause unnecessary pain, and another may be the cause of unpleasant and even of dangerous symptoms due to its absorption.

Henry A. Griffin.

LINSEED, *linum* (U. S. Ph.), *lini semina* (Br. Ph.), *semen lini* (Ger. Ph.), flaxseed, is the dried ripe seed of *Linum usitatissimum*, the common flax, a plant which is cultivated almost universally. The seeds are oval and flattened, having sharp edges and somewhat pointed extremities. They are from $\frac{1}{6}$ to $\frac{1}{4}$ of an inch in length, externally brown and shining, and internally yellowish-white. They have no odour, but a mucilaginous taste. They contain fixed oil, wax, resin, extractive, tannin, gum, mucilage, albumin, gluten, and salts. The epithelium of the seeds contains an abundance of mucilage, which is soluble in hot water, and forms with it a viscid fluid. The fixed oil is plentiful in the interior of the seed, and when expressed without the aid of heat is known as linseed oil, *oleum lini* (U. S. Ph., Br. Ph., Ger. Ph.). The seeds when ground form a grayish meal, which is known as ground linseed, flaxseed meal, or linseed meal, *lini farina* (Br. Ph.). This meal should be freshly ground in order to be highly oleaginous and free from rancidity; but, unfortunately, much of that which is sold does not conform to these requirements. The cake of linseed which remains after the oil has been expressed is known as oil cake, *placenta seminis lini* (Ger. Ph.), and when ground is known as cake meal, and it is this which is often substituted for freshly

ground linseed meal in commerce. The impropriety of employing this cake meal medicinally lies not only in its poverty in oil, but, more still, in its liability to rancidity.

Linseed is *demulcent.* For internal administration an infusion, linseed tea, is the most desirable preparation, and should be made in the proportion of ½ an oz. of the whole seeds to 1 pint of boiling water. A decoction of linseed is undesirable, because it will contain a certain amount of the oil of linseed, and this, from its disagreeable taste, renders the preparation less palatable. Such a decoction, however, is highly spoken of as a laxative enema. The infusion of linseed, when properly prepared, is a demulcent drink, which may be used without limit as to amount, and is highly desirable in *irritative* and *inflammatory conditions,* whether alimentary or not. It is particularly efficient as a demulcent and diluent in *irritation* and *inflammation of the urinary organs,* whatever may be the cause. In *bronchial inflammations* also it is serviceable, and it may be beneficial in *diarrhœa* and *dysentery.* The too copious imbibition of fluids in diarrhœal conditions, however, is in many cases responsible for their prolongation. The infusion is not disagreeable in taste, though insipid, but it may be made more acceptable by the addition of lemon-juice and sugar; or in its stead may be used the so-called compound infusion, which was official in the U. S. Ph. of 1870, and is recognised as *infusum lini* (Br. Ph.). This is an infusion of linseed and licorice root in the proportions of 150 grains of the former and 50 grains of the latter to 10 ounces of boiling distilled water. The infusion should be carried on in a covered vessel for two hours, and the product should be strained.

The more valuable therapeutical employment of linseed, however, is its external use in the well-known and universally employed flaxseed poultice. This poultice is an emollient application of the utmost usefulness, and is official as *cataplasma lini* (Br. Ph.), a preparation made with 2 parts of linseed meal and 5 parts of boiling water, gradually mixed with constant stirring. The extemporaneous preparation of flaxseed poultices involves no such nicety of measurement, however, and in professional and domestic practice alike the mixture of flaxseed with hot water is so made that a mass of suitable consistence shall be obtained, weights and measures being disregarded. (See under POULTICES.)

Oil of linseed, *oleum lini* (U. S. Ph., Br. Ph., Ger. Ph.), is a yellow oily liquid which, as I have said, is obtained from linseed by expression and without the use of heat. Its odour is slight but peculiar, and its taste bland and oleaginous. It is soluble in absolute alcohol, and very soluble in ether and in chloroform. On exposure, it becomes thickened and rancid. Though much used in the arts, linseed oil has but an infrequent medicinal employment. Given in doses of about 1 ounce, it is laxative, but is objectionable because of its disagreeable taste. It is, however, a desirable addition to purgative enemata.

[Dr. Samuel Sherwell, of Brooklyn, has made extensive use of linseed oil as a *nutrient* in various *cachectic conditions.* He prefers the oil made from the linseed that is imported from Calcutta. He uses it both internally and externally. One of the forms in which he has employed it is that of bread made of the freshly ground seed, with a sufficient admixture of wheat flour. This bread is not unpalatable, and may be eaten freely for considerable periods, generally without disturbing the stomach.]

HENRY A. GRIFFIN.

LINT, *linteum carptum, charpie,* is linen made soft and fleecy by one or another mechanical process. It may retain more or less the body and texture of the original fabric, or it may be converted by scraping into a flossy mass with no recognisable fibre. Charpie is made by unravelling old linen and cutting the threads into suitable lengths, usually from four to six inches. The lint which retains the cloth-like texture is made by cutting the threads of linen in one direction and at short, regular intervals so that the cut ends, becoming unravelled, cause the surface to become fleecy. Lint of this sort is now made by machinery from cloth manufactured for the purpose. It is thicker than the hand-made article and has the advantage of uniformity. It should tear easily in one direction, should be soft, absorbent, firm enough to be easily spread with an ointment, and sufficiently tenacious to enable one to remove it from a wounded surface without leaving bits of lint adherent.

Cotton should not enter into the composition of good lint. The cotton fibre is harsher, less absorbent, and not so good a conductor of heat as the linen. The best test for cotton or linen is by the microscope. The cotton threads are flat and twisted, the linen cylindrical with node-like enlargements, like miniature bamboo. Linen thoroughly oiled is transparent. Cotton remains opaque.

Formerly lint in one or another form was used very extensively as a surgical dressing, much as we now use the various gauzes, etc. The flocculent lint and charpie were of special use in absorbing the discharges from wounds. At the present time the lint which is almost exclusively used is the so-called *patent* article—smooth on one side, flossy on the other. It is of value in applying ointments to large surfaces, the mass being spread with a spatula on the smooth side. The flossy part is to increase the body of the fabric and to promote absorption. Lint is of especial use in dressing *extensive burns* or other lesions of the skin where there is extreme sensitiveness. It is often placed next to the skin and then covered by as much gauze or other dressing as may be needed for antiseptic or absorbing purposes.

Pads of folded lint sewed together are useful in applying hot or cold fluids to a part. They are especially adapted to use about the eye, because when sewed with the fleecy side turned in it is not likely that threads or fibres will become detached and irritate the parts.

Lately a soft, smooth fabric impregnated with one or another bland ointment has been manufactured. It is a kind of mull and is

named according to the ointment contained. *Zinc mull*, for example, is made with zinc-oxide ointment thoroughly mixed and very smooth. It is an elegant preparation, and is used mostly by dermatologists.

ARPAD G. GERSTER.
HOWARD LILIENTHAL.

LINUM.—See LINSEED.

LIPANIN.—Under this name a 5- or 6-per-cent. solution of oleic acid in olive oil has been proposed as a substitute for cod-liver oil. It is given in doses of a liqueurglassful, before meals.

LIPPIA MEXICANA.—The leaves of this Mexican verbenaceous shrub, which contain a camphor termed *lippiol*, have been used as an *expectorant* and as a remedy for *asthma*. A tincture is made with 1 part of the fresh leaves and 9 parts of alcohol; the dose of this is from ½ to 1 fl. drachm.

LIQUIRITIA, LIQUORICE.—See LICORICE.

LIRIODENDRON TULIPIFERA. — The bark of this American magnoliaceous tree, the tulip tree, has been employed in *malarial fevers* as a *diaphoretic*, and as a *tonic*. It has been supposed to have a special tonic action on the heart. It contains an acrid resin, *liriodendrin*, which is probably its active principle. The dose of the powdered bark is from ½ to 2 drachms; that of a strong tincture, 1 fl. drachm.

LISTERINE.—This is an American proprietary preparation said to consist of oil of eucalyptus, oil of wintergreen, menthol, thymol, boric acid, alcohol, and water. It is a mild and agreeable *disinfectant* and *local stimulant* much employed where an energetic action is not necessary. Diluted with water, it is a refreshing and efficient mouth wash.

LITHARGE.—See *Lead oxide*, under LEAD.

LITHIUM.—The preparations of lithium have attained considerable reputation as *antarthritics*, and the preparations which are most used are the carbonate, the hippurate, and the salicylate. The carbonate, *lithii carbonas* (U. S. Ph., Br. Ph.), *lithium carbonicum* (Ger. Ph.), has the disadvantage of being exceedingly unpleasant to take, unless in the form of an aerated water, and has largely given place in the treatment of *gouty manifestations* to the hippurate and the salicylate, *lithii salicylas* (U. S. Ph.).

[The dose of the carbonate is from 3 to 6 grains. It is almost insoluble in water, but carbonic-acid water converts it into a soluble bicarbonate, as in the lithia water, *liquor lithiæ effervescens*, of the Br. Ph., the dose of which is from 5 to 10 fl. oz. The citrate, *lithii citras* (U. S. Ph., Br. Ph.), may be given in doses of from 5 to 10 grains. The *lithii citras effervescens* of the U. S. Ph. is a powder of lithium carbonate, sodium bicarbonate, citric acid, and sugar. It effervesces on being dissolved in water, and the citrate is formed. The dose is from 1 to 2 drachms.]

The hippurate or salicylate may be given in doses of from 10 to 20 grains at intervals of three hours up to the amount of from 1½ drachm to 2 drachms a day. The fact that they are alkalies would help to explain, to a certain extent, some of their beneficial effects in gouty manifestations in which the line is not definitely marked between gout and rheumatism. The effervescent granular salt of lithiated potash makes a very agreeable way in which to administer the drug, and oftentimes efficacious.

[Lithium benzoate, *lithii benzoas* (U. S. Ph.), is another preparation used as a remedy for *gout*. The dose is from 15 to 30 grains. The bromide, *lithii bromidum* (U. S. Ph.), has been employed in medicine rather for the effect of the bromine it contains than for that of the lithium. In cases in which the bromides are indicated (see BROMIDES) it may be given in doses of from 15 to 30 grains.

Mendelsohn (*Dtsch. med. Woch.*, Oct. 10, 1895; *Brit. Med. Jour.*, Nov. 16, 1895, *Epitome*) combats the theory that lithium salts are of benefit in gout by forming soluble compounds with uric acid and thus favouring its elimination. He thinks that the *diuretic* action of the lithium salts has much to do with their beneficial effects, and this action he professes to have proved abundantly, using for the most part the acetate and the citrate, the latter of which he has found to have the most decided diuretic action.

Natural mineral waters containing lithium have come into extensive use of late years in the treatment of the *gouty tendency* and *urinary lithiasis*. Conspicuous examples are the Buffalo lithia water of Virginia and that of the Londonderry spring in New Hampshire. Cf. LITHONTRIPTICS.]—A. ALEXANDER SMITH.

LITHONTRIPTICS are substances administered for the purpose of dissolving renal or vesical calculi. They act either by dissolving the calculous formation or by forming soluble compounds with the elements composing the stone. The former method is applicable only in the case of vesical calculi, and has proved quite impracticable, owing to the action of the agent used on the mucous membrane of the bladder. The formation of soluble compounds of uric acid is equally difficult to accomplish in the human body. In fact, the logic of the process is almost entirely false, for a calculus once formed is practically immovable from the body by chemical means. The most that the so-called lithontriptics can be expected to do is to relieve the excessive secretion of uric acid and the insoluble urates. Some of the drugs used for this purpose, however, do seem to have the effect of relieving some of the urgent symptoms of vesical calculus, probably by their diuretic action, increasing the flow of urine and thus palliating the irritation of the urinary passages. With the advance in genito-urinary surgery and its increased safety there seems little need at the present time of resorting to chemical influences to free the body from calculous deposits.

The theory on which lithontriptic drugs have been used was set up by the established fact that after removal from the body certain sub-

stances dissolved uric acid and phosphatic calculi. Given by the mouth, these same drugs exert but little solvent power, being largely changed by their contact with the digestive fluids and by the blood. Injected into the bladder, they are apt to cause local disturbance; and the small amount capable of being thus introduced renders their use of little benefit.

In a careful review of the subject, and after many personal experiments, Roberts (*Treatise on Urinary and Renal Diseases*, 1885) concluded that the local treatment of calculi was not serviceable. He found that dilute nitric acid, as recommended by Sir Benjamin Brodie, would dissolve small vesical calculi, but that the quantity which could be safely used was too small to be of great service. The urine, as is well known, can be rendered alkaline by the administration of the carbonate or acetate of potassium, and the alkaline carbonates will dissolve uric-acid calculi. But, although the carbonate of potassium exercises some solvent power, its action is too limited to receive unqualified indorsement.

A very long list of lithontriptics is given in the text-books. Those which have received the greater number of tests and are, therefore, the most important, will be briefly reviewed. As early as 1821 *electricity* in the form of the galvanic current was recommended for the disintegration of stone; but this treatment possesses at present a merely historic interest. *Water* probably is the best lithontriptic agent. When it is given in large quantities, the urine becomes well diluted. The ease of micturition is thereby enhanced, and it is possible that very small calculi in the pelvis of the kidney or in the bladder may be dissolved and passed off. The virtues of the lithia waters for similar therapeutic purpose are unquestionably due to the large amounts of water ingested; for they contain only from $\frac{1}{6000}$ of a grain to 1 grain of some lithium salt to a pint of water, and it is manifestly absurd to attribute solvent power to such a small amount of chemical substance. Aside from making the urine alkaline, many of the mineral waters recommended for the same purpose must be placed in the same category. The famous Carlsbad springs in Austria, and in the United States the Lithia springs of Virginia, the Gettysburg springs of Pennsylvania, and the Sheldon springs of Vermont, have some reputation in this connection.

The salts of *lithium* have had reputations as solvents of calculi ever since the publications of Ure and Garrod. The *benzoate of lithium*, in solution, dissolves uric-acid stone outside of the body, as do also the *citrate* and the *carbonate of lithium.* These salts render the urine alkaline and have a diuretic action of decided value upon which their fame as lithontriptics probably rests. Authorities are still at variance as to their action on calculi when administered by the mouth. The dose is from 1 to 3 grains, thrice daily, well diluted in carbonated or plain water.

Potassa, potassium acetate, and *potassium bicarbonate* are likewise diuretic and make acid urine alkaline. The last-named salt has attributed to it the faculty of dissolving and eliminating urates and an excess of uric acid. The three preparations lessen the irritability of the bladder when calculi are present and are said to diminish pain and the frequency of urination. Their virtues depend, in all likelihood, on their stimulant action on the renal epithelium and on the reversal of the urinary reaction. The dose of the salts is from 30 to 40 grains in twenty-four hours, in divided doses, given in much water or red wine.

The salts of *sodium* have also been used for the purpose of dissolving and eliminating calculi. *Sodium borate* enters the urine unchanged chemically, and the sodium combines with uric acid to form the soluble sodium urate, freeing boric acid. The excess of uric acid is thus taken care of; but it is doubtful if a formed stone can be dissolved by the salt. It is given in doses of from 5 to 30 grains, much diluted. *Sodium bicarbonate* has less repute than the potassium salt.

Nitric acid, *phosphoric acid*, *hydrochloric acid*, and *sulphuric acid* have all been recommended and used for the dissolution and elimination of phosphatic calculi. They are administered for this purpose in doses of from 5 to 30 drops, well diluted.

Piperazine (*q. v.*) has in recent years achieved some reputation as a lithontriptic and as an alterative in the "*uric-acid diathesis.*" Better results have been alleged for it than have been achieved by the use of lithium or alkaline salts. It is said to dissolve oxalic and phosphatic as well as uric-acid calculi. Observation is still too incomplete for positive statements, although patients suffering from "gravel," or *lithiasis*, seem to feel very comfortable under its use. It may be injected into the bladder or subcutaneously in a 2-per-cent. solution, or it may be given by the mouth in doses of from 15 to 45 grains.

All the drugs known to have a diuretic action and those which can reverse the acid reaction of the renal excretion have been recommended as lithontriptics. Some of them are, in their usual doses, *uva ursi*, *limewater*, *ammonium benzoate* and *borate*, *magnesia*, *magnesium borocitrate*, *triticum repens*, *hydrangea*, *pichi*, *oil of turpentine*, *wild potato*, *pareira brava*, and *lead saccharate*.

Samuel M. Brickner.

LOBELIA (U. S. Ph., Br. Ph.), *herba lobeliæ* (Ger. Ph.), is the dried, flowering herb of *Lobelia inflata*, Indian tobacco, a weed growing throughout the United States. The drug has a slightly irritating odour and a taste which is mild at first, but later burning and acrid and productive of salivation and sometimes of nausea. It contains gum, resin, fixed oil, lignin, salts, chlorophyll, a volatile oil, a peculiar acid called *lobelic acid*, and an alkaloid termed *lobeline*.

The effect of a full dose of lobelia is to cause extreme nausea, with vomiting which is prolonged and accompanied by the most intense prostration, the pulse being feeble, the skin pale, cold, and bathed in perspiration, and the

general condition one of utter relaxation. Headache and dizziness are also observed, and diuresis and catharsis may occur. If the dose has been poisonous, all these symptoms are intensified, but vomiting is occasionally absent, and then the constitutional symptoms are unusually severe and death is apt to follow. In persons poisoned with lobelia there are also burning pain in the œsophagus and stomach, tremors, shallow breathing, stupor, coma, and finally collapse terminating in death. In some cases convulsions precede the fatal termination. Death is due to paralysis of respiration. The treatment in poisoning by lobelia consists in thoroughly emptying the stomach, preferably by washing, and the administration of stimulants and sedatives as they may be required. Experimental evidence is strong that the action of lobelia is to depress and finally to paralyze the motor nerves.

Although lobelia may be used as an emetic, it is unsafe for this purpose, because of its dangerous action when absorbed, and the rapidity with which that action is manifested. It may also be used as a depressing expectorant, but, as a matter of fact, it is seldom used save as an antispasmodic, and chiefly for the relief of *asthma*. In an asthmatic paroxysm the tincture of lobelia of the U. S. Ph. may be given in doses of from 7 to 15 minims; that of the Br. Ph., in doses of from 10 to 20 minims; that of the Ger. Ph., in doses of 15 minims. These doses may be repeated hourly until relief is obtained or until the disagreeable effects of the remedy become manifest, but it is not quite safe to give more than five doses in the course of twenty-four hours. Other spasmodic affections have been treated with lobelia, *whooping-cough* in particular, and occasionally *chorea*, *epilepsy*, *convulsions*, and *tetanus*. The remedy is not more effective in these states than others whose actions are less dangerous. As a depressing expectorant and antispasmodic lobelia is useful at times in cases of *bronchial cough* in which there is little expectoration, and in which the cough is harassing and wearing and perhaps made worse by bronchial spasm. The remedy has been used as a relaxing emetic in *spasmodic croup*, but the objection to its emetic employment is too strong to justify its administration in this disease. Lobelia is said to be useful in *habitual constipation* due to intestinal atony and deficient secretion. For such cases 10 minims of the tincture may be given at bedtime. Like tobacco, lobelia in infusion may be efficient in *strangulated hernia*, *intestinal intussusception*, and *fæcal impaction* when given by enema.

The tincture of lobelia, *tinctura lobeliæ* (U. S. Ph., Br. Ph., Ger. Ph.), is the preparation most commonly employed. The strength of the U. S. preparation is 20 per cent., and the dose is from 5 to 60 minims. The strength of the British tincture is 12·5 per cent., and the dose, according to the Br. Ph., is from 10 to 30 minims. The German is a 10-per-cent. tincture. The dose of the ethereal tincture of lobelia, *tinctura lobeliæ ætherea* (Br. Ph.), is from 10 to 30 minims. The fluid extract of lobelia, *extractum lobeliæ fluidum* (U. S. Ph.), is a good preparation. The expectorant dose is from 1 to 5 minims; the emetic dose, from 10 to 20 minims. Lobelia is not a remedy to be carelessly used, and, whatever the preparation, much caution must accompany its administration.

[*Lobeline* has been used for the same purposes as lobelia, in doses of from $\frac{1}{60}$ to 1 grain of the sulphate, but too little has been recorded concerning it to warrant its recommendation.]

HENRY A. GRIFFIN.

LOCO-WEED.—The word *loco* is a Spanish adjective, which means mad. It has been applied to certain plants west of the Mississippi River, because animals eating them become diseased, and the symptoms are so peculiar that the term is applied not only to the plants which are known as loco-weeds, but to the disorder as well, and the animals thus suffering are said to have loco disease.

The earliest recorded reports of the loco-weeds come from California. Mr. O. B. Ormsby and Mr. T. S. Whipple have both sent carefully observed records (*Report of the Dept. of Agriculture*, 1874, p. 159). Since then, from various localities of the great plains have come numerous reports of the ravages among stock, horses, cattle, mules, and sheep caused by eating these plants.

The two loco-weeds best understood are the *Astragalus mollissimus* and *Oxytropis Lamberti* (U. S. Botanist, *Report of the Dept. of Agriculture*, 1884, p. 124). The *Astragalus mollissimus* is a perennial herbaceous plant of the region of the great plains. It belongs to the order *Leguminosæ*. There are usually a great many stalks proceeding from a large, strong root-stalk. They are reclining toward the base and erect above. These stalks are so short that the leaves and flower-stalks seem to proceed directly from the root. They are branching at the base, and give rise to numerous leaves and long stems bearing the flowers and pods. The leaves are usually from 6 to 10 inches long, composed of from 9 to 15 leaflets, in pairs except the upper one. These leaflets are of oval form, $\frac{1}{2}$ to $\frac{5}{8}$ of an inch long, and of a shining silvery hue, from being clothed with soft silky hairs. The flower-stalks are about as long as the leaves, sometimes longer, naked below, and at the upper part ($\frac{1}{4}$ to $\frac{1}{2}$) bearing a rather thick spike of flowers, which are nearly an inch long, narrow, and somewhat cylindrical, the corolla of a purple colour, the calyx half as long as the corolla and softly pubescent. The flower has the general structure of the pea family, and is succeeded by short, oblong pods $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long, which contain the small dark-brown seeds.

The *Oxytropis Lamberti* belongs to the same family, but differs chiefly from the *Astragalus mollissimus* in having a more erect habit, shorter leaves, longer flower-stalks, and longer, narrower leaflets, an inch long and from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch wide.

Stockmen of intelligence and experience state that the loco-weeds do not grow with equal abundance in all years; but there is no regularity in their plentiful growth, as two very

bad years for stockmen on account of it were within four years of each other, while it had not been abundant for several years prior to that time. The economic importance of the subject can be readily understood when it is known that, according to a conservative estimate, 25,000 head of cattle perished from the loco disease within an area of 35 by 120 miles in southwestern Kansas in the year 1883, a season of very abundant growth of the loco-weed.

In all reliable observations and records of this subject there is general agreement in regard to certain effects produced by the plant—viz., emaciation, roughness of the coat, acquired taste for the plant, and derangements of the nervous system (especially convulsive and maniacal symptoms). In the cases produced experimentally by myself (*N. Y. Med. Jour.*, March 2, 1889), preceding these marked symptoms there were always digestive disturbances, increased salivary secretions, retching, sometimes vomiting, and invariably diarrhœa. Ott reports increased action of the salivary glands (*Med. Record*, Feb. 18, 1888). M. Stalker speaks of digestive disturbances, but does not specify them (*Report to the U. S. Bureau of Animal Industry*, 1886, p. 273). Mr. C. P. Fullington (who is also quoted in the Kansas *State Board of Agriculture Report*, 1889–'90) stated in a personal interview that during the year 1883 he had lost 1,800 head of cattle out of a herd of 4,000 from their eating loco-weed, and that diarrhœa was always present, but he could not say that it was one of the first effects, as they did not usually notice cattle in the herd until they were markedly under the influence of the plant. On his own ranche in Kiowa County, and upon that of Mr. Arthur Gorman, Comanche County, Kansas, during the year 1883 the losses were so great that men were hired to cut out the plant; but this was not successful, as the men invariably began to complain of nausea, vomiting, and sick headache after a few days, and nothing would induce a man to cut more loco-weed after these symptoms came on.

The animals eat the whole plant except the root, so it is not known what part contains the poison. All observers agree that it requires a great amount of the plant to produce a fatal result, and that if an animal has shown decided symptoms of the loco disease it never voluntarily stops eating the plant, but eats it in preference to all other food. If it is deprived of it, the disease may not be immediately fatal, but the animal *never fully* recovers. From the consideration of the preceding facts it would seem that the loco-weed has upon the organization of the lower animals *primarily* the effect of increasing the flow of saliva and of causing gastro-intestinal irritation; *secondarily*, a narcotic effect, as shown by the acquired taste and nervous derangements.

Several chemical analyses have been made to separate the toxic principle. The U. S. Chemist reports an alkaloid in small amount and a bitter extractive (*Rep. of the Dept. of Agriculture*, 1879). Miss Catherine Watson reports an alkaloid and a resin (*Am. Jour. of Pharm.*, 1878). Professor Sayre obtained alkaloidal reactions (*Report of the Kansas Board of Agriculture*, 1891–'92). Professor F. B. Power and F. Gambier report a small quantity of an alkaloid (*Pharm. Rundschau*, Jan., 1891). All of the experimental work of the writer has been done with the decoction and dilute alcoholic extracts of the same (*N. Y. Med. Jour.*, Nov. 3, 1889). Both preparations contain the toxic principle, are acid in reaction, bitter to taste, and nauseating in odour; but it has not been possible to do a sufficient amount of experimental work to make positive statements as to the chemical character of the active principle, or perhaps principles, justifiable.

Allied plants thought to have similar properties, but not so well studied, are *Sophora sericea*, *Oxytropis multifloris*, *Oxytropis deflexa*, *Malvastrum cœcineum*, and *Corydalis aurea*, variety *Occidentalis*.

Mary Gage Day.

LOGWOOD.—See Hæmatoxylon.

LORETIN.—This is the trade name of an iodine derivative of oxyquinolinesulphonic acid, a yellow, odourless powder used as a *disinfectant*. It is reported to be harmless and quite as efficient as iodoform. Korff (*Münch. med. Woch.*, 1895, No. 28; *Ctrlbl. f. Gynäk.*, Nov. 30, 1895) reports that he has used it in about 260 cases in the course of two years in preparing parts to be operated on, during operations, in dressings, and in the after-treatment of operation wounds. In only one case did erysipelas occur, and most of the wounds healed by first intention. He regards loretin as a powerful preventive of erysipelas and eczema. He uses it in a 2-to-1,000 watery solution, in the form of a 5-per-cent. ointment with vaseline or lanolin, in pencils containing from 5 to 10 per cent. of the drug, in the form of collodion holding 4 per cent. of loretin in suspension, and, mixed with talc or calcined magnesia, as a dusting powder.

Dr. Herbert Snow, of the London Cancer Hospital (*Brit. Med. Jour.*, Dec. 21, 1895), says of loretin: "My own experience is confined to the powder, which I have never found occasion to mix with any other substance. Dusted on the skin, or over a granulated wound, this causes not the slightest irritation or unpleasant sensation. It immediately destroys the malodour of the most *fœtid cancerous sore*, controlling this in a manner which no other agent I have yet tried will do. Copiously puffed with an insufflator into the deep cavity formed by evacuating the axilla of carcinomatous glands, it efficiently precludes *suppuration*, even when free hæmorrhage has taken place after the closing of the wound, an occurrence almost inseparable from anæsthetic vomiting when the patient has been removed from the operating-table. Not the slightest bad symptom from its employment in this way has so far been detected. When there is no deep cavity, a wound dusted with loretin heals rapidly by first intention. I have had recourse to loretin in some sixty cases, mainly operations on the breast and axilla, notoriously a test region for antiseptics. In my hands

it has proved an ideal antiseptic and deodorant, with no single drawback; and I am sure that no surgeon who has once tried it will ever again resort to the noisome and toxic iodoform, from the free use of which I have seen more than one death. Though whenever old-established agents answer sufficiently the purpose, I have a strong prejudice against novelties, yet this substance—non-poisonous, devoid of smell, and absolutely preventive of suppuration—seemed to me so marked an advance upon anything previously brought forward that I felt constrained to direct thereto the notice of the section" (meaning the Section of Pharmacology and Therapeutics of the British Medical Association).

In a subsequent communication (*Brit. Med. Jour.*, Dec. 28, 1895) Dr. Snow points out a peculiar quality which the six months' experience gained since the meeting has shown him it possesses. "While taking first rank as a non-poisonous, non-irritating, odourless antiseptic and deodorant," he says, "I find that when dusted on a raw surface it relaxes the blood-vessels. Hence the wound is prone to become subsequently filled by a clot, which, however, does not suppurate, as would be the case under almost any other circumstances, but is eventually reabsorbed. The incident is not desirable, and I now apply loretin only to the skin surface, never dusting it into a cavity unless there be special risk of suppuration, and then only very sparingly. I would take leave to add that long experience has shown me the ideal condition in which to leave any operation wound to be the utmost attainable maximum of dryness, avoiding all swabbing with fluids, however antiseptic. It is probable that the efficacy of iodoform, loretin, and the like is very largely due to their capacity for absorbing moisture, without which microbe proliferation does not occur."

LOSOPHAN, or cresol triiodide, $CH_6HI_3 < \begin{matrix}(OH)_2\\(CH_3)_4\end{matrix}$, is a colourless, odourless, crystalline substance formed by the action of iodine on oxytoluic acid in the presence of sodium carbonate. It has been used topically by Saalfeld (*Therap. Monatsh.*, Oct., 1892) in *tinea tonsurans*, *tinea versicolor*, *prurigo*, *chronic eczema with infiltration*, *sycosis*, *acne*, *rosacea*, and *pruritus*. In some cases it proved so irritating that its employment had to be suspended. Saalfeld used a solution of from 1 to 2 per cent. in a mixture of 3 parts of alcohol and 1 part of water, applied from two to three times daily with friction; also a 1-, 2-, or 3-per-cent. ointment.

LOTIONS, *lotiones*, or washes, are liquid preparations that are composed of medicinal agents dissolved or suspended in water or other liquid menstrua, and are applied externally for various remedial purposes. In accordance with the therapeutic properties of the dissolved or suspended drug, a lotion may be an irritant or counter-irritant, a rubefacient, a vesicant, an emollient, an astringent, a sedative or anæsthetic, or an antiphlogistic agent. At one time a large number of lotions were generally employed in medicine; but the introduction of oleates, glycerites, and similar preparations, and the fact that the physician could best determine the strength of the solution of any medicament he desired to employ externally, have resulted in the omission of this class of preparations from the U. S. Ph., though it is retained in the Br. Ph., in order apparently to officially recognise black and yellow washes.

Lotions are generally applied for their local effect, though they may be used sometimes for the purpose of introducing drugs into the system.

Black mercurial lotion, *lotio hydrargyri nigra* (Br. Ph.), *aqua phagedænica nigra*, black wash, is prepared by mixing 30 grains of calomel and 10 fl. oz. of solution of lime. The *National Formulary* directs that 64 grains of calomel shall be triturated with ½ oz. of water and gradually added to a sufficient quantity of solution of lime to make 16 fl. oz. The mixing produces a chemical reaction between the calomel and the lime that results in the formation of calcium chloride and black mercurous oxide. The mixture should be well shaken when used. It is applied as an antiseptic stimulant, and astringent dressing to *venereal ulcers*.

Yellow mercurial lotion, *lotio hydrargyri flava* (Br. Ph.), *aqua phagedænica*, yellow wash, is prepared by mixing 18 grains of corrosive sublimate with 10 fl. oz. of solution of lime. It may also be made by dissolving 24 grains of corrosive sublimate in ½ oz. of boiling water which is added to enough solution of lime to make 16 fl. oz. This preparation, too, should be well shaken when used. It is employed as an antiseptic and stimulant wash in *syphilitic* and other *chronic ulcers of the skin*.—Samuel T. Armstrong.

LOVAGE.—See Ligusticum.

LOZENGES.—See Troches.

LUPULIN, *lupulinum* (U. S. Ph., Br. Ph.), is the glandular powder which separates from the strobiles of hops, with which it has identical properties (see Humulus). It may be given in pill in doses of from 2 to 5 grains or in the shape of the fluid extract, *extractum lupulini fluidum* (U. S. Ph.), in doses of from 10 to 15 minims, or in that of the oleoresin, *oleoresina lupulini* (U. S. Ph.), in doses of from 2 to 5 grains.—Russell H. Nevins.

LUPULUS (Br. Ph.).—See Humulus.

LYCETOL is a German proprietary name for dimethylpiperazine tartrate. It has been brought forward as a remedy for *gout* and *urinary lithiasis*, being said to have the alleged property of piperazine as a resolvent of uric acid and in addition that of maintaining, in gout, the dissolved state of the acid in the blood by rendering that fluid alkaline. Besides, it acts as a *diuretic*. It is given in daily amounts of 15 grains, and its administration should be continued for at least a fortnight.

LYCOPODIUM (U. S. Ph., Br. Ph.), vegetable sulphur, is composed of the sporules of a plant commonly called club moss, *Lycopo-*

dium clavatum, and of other species of *Lycopodium*. The commercial product is a very fine pale-yellowish or buff powder, inodorous, tasteless, and so light and oily that it floats upon water. It is quite combustible when brought in contact with a flame, and is used to make flames for theatrical effect.

It was formerly asserted that the moss possessed *diuretic* and *antispasmodic* properties, and it was given in decoction in renal and pulmonary disorders. These properties, however, exist in so moderate a degree that other and more active remedies are preferred to secure such effects.

Lycopodium is a bland powder that has been used as an application to *excoriated surfaces*, especially in the skin folds of children. As it is sometimes adulterated with starch, and its vegetable character facilitates decomposition, it has been supplanted by powdered talc as an application for the purpose named.

Mr. E. Hurry Fenwick has stated that ½-drachm doses of a tincture, made by triturating lycopodium with sugar of milk for a long time, after which it will readily dissolve in alcohol, is a valuable remedy for *incontinence of urine* in either children or adults, in doses of from 15 minims to 1 fl. drachm. The tincture is commended by Greene as a remedy for *flatulent dyspepsia* associated with *uric-acid deposits in the urine*.

Adrian states that he has isolated from *Lycopodium Saussurus* an alkaloid that he calls *piliganine*, which acts upon animals to produce vomiting, purging, and convulsions.

SAMUEL T. ARMSTRONG.

LYSOL.—This is a saponaceous coal-tar product consisting largely of cresols. It is a brownish, clear liquid, having somewhat the odour of creosote. It mixes readily with water, alcohol, or glycerin. It is used as an *antiseptic* and has been found very efficient in *inflammatory affections of the throat*, in *ozœna*, in *fermentative dyspepsia*, in *dysentery* (as an injection), in *gonorrhœa*, and in *leucorrhœa*, also in the treatment of *eczema* and *lupus*. It may be given internally in doses of from ¾ to 8 grains. A 1-per-cent. solution may be used for disinfecting the hands and the field of a surgical operation, as an injection in gonorrhœa, and for irrigating the nasal passages; a 2-per-cent. solution is appropriate for vaginal injections and for the treatment of skin diseases. Lysol is considered too irritating for use within the bladder.

Several cases of poisoning with lysol have been reported. In two instances observed by Kämpffer (*Dtsch. med. Woch.*, 1894, No. 34; *Ctrlbl. f. Gynäk.*, Sept. 14, 1895) an exceedingly severe dermatitis followed the employment for a comparatively short time of compresses wet with a solution of the strength of from ½ to 1 per cent. to small wounds. That observer particularly urges that when vaginal injections of lysol are employed great care should be taken that no excess of the solution remains in the vagina. Dr. A. J. Comstock, of Ventura, Cal. (*Med. News*, Aug. 17, 1895), reports a case of poisoning by the accidental administration of lysol internally. The patient was a healthy woman, twenty-four years of age. Three days after her confinement she was given, by mistake, a tablespoonful and a half of lysol. The drug was taken early in the morning upon an entirely empty stomach, but was diluted with two ounces of coffee. The woman was immediately seized with violent burning pain in the mouth, throat, and stomach. It was forty-five minutes before a physician reached her, in the mean time nothing in the way of a diluent or emetic had been administered, and vomiting had not occurred. When the physician who had been called in Dr. Comstock's absence reached the patient he at once administered oils, eggs, diluents, and emetics. The patient was then in a partially comatose state, very pale, perspiring profusely, and with the muscular system in a state of complete relaxation. Respiration was slow and shallow and the pulse imperceptible. As emesis did not readily occur, the physician went for a stomach-pump, but upon his return found the woman vomiting freely. The poison had then been retained two hours and forty-five minutes. After the vomiting, consciousness partially returned, but the patient remained very weak. Dr. Comstock first saw her three hours after the poison had been swallowed. She was then still partially unconscious, with great muscular relaxation, a very weak and rapid pulse, and the pupils widely dilated. He at once administered another emetic (20 grains of ipecac in powder) and large quantities of warm water, until free emesis occurred, twelve minutes afterward. The woman was then given small and frequently repeated doses of magnesium sulphate until free purgation was produced. The after-treatment consisted in the use of flaxseed tea, bismuth, and restricted diet. The subsequent gastritis was slight, but for forty-eight hours there was partial suppression of urine, with albumin present in large amount. The albumin disappeared on the fourth day and the secretion of urine became re-established. In a week after the accident the patient appeared fully convalescent.

LYTTA.—See CANTHARIDES.

MACE, *macis* (U. S. Ph.), and oil of mace, *oleum macidis* (Ger. Ph.), are used chiefly for flavouring purposes, occasionally as *carminatives*. Mace may be given in doses of from ¼ to 1 grain; the oil, in doses of from 1 to 3 drops, on sugar.

MAGNESIA AND THE SALTS OF MAGNESIUM.—**Magnesia,** or *magnesium oxide*, MgO, occurs in two forms, the light or calcined, the *magnesia* (U. S. Ph.), *magnesia levis* (Br. Ph.), *magnesia usta* (Ger. Ph.), and the heavy, *magnesia ponderosa* (U. S. Ph., Br. Ph.), differing somewhat in their physical, but not in their chemical and medicinal properties. Unless otherwise stated, the light variety is the one dispensed when magnesia is ordered. Its effects are similar to those of the

other alkalies, but are much less decided, and the salts of potassium and sodium are preferred when alkalinization of the fluids of the body is desired. Although regarded as a *cathartic*, it does not act as one except when there is considerable acid in the stomach and intestines, or it is given simultaneously with citric acid, through the agency of which it is ultimately converted into the bicarbonate, a salt which is decidedly laxative. On account of its freedom from taste and its non-irritating and antacid properties, it is a very desirable preparation to administer to children, especially combined with tincture of rhubarb, in *diarrhœa* with acid stools containing undigested food. *Headache* which is dependent upon indigestion, particularly when accompanied by acidity, is often removed by full doses. The *nausea of pregnancy* is sometimes relieved by it, but no great amount of reliance can be placed on it in this condition. It is a useful addition to colchicum when that remedy is indicated in *gout*, and gives the best results when the urine is acid and high-coloured. Externally, it is used as a dusting powder, especially when the perspiration or any other secretion is acid, to relieve the irritation of *sunburn*, and after shaving. For the latter purposes it is compressed into blocks or cakes, which are very convenient, as there is less waste and no danger of the powder being scattered around. When mixed with water, usually in the proportion of 1 part of the magnesia to 7 or 8 parts of water, it is converted into the *hydrated oxide*, which stands next in efficiency to iron hydrate in the treatment of *acute arsenical poisoning*. On account of its considerable absorptive qualities and the non-irritating properties and insolubility of most of its salts, it is better than the other alkalies as an antidote in the treatment of *poisoning by mineral and vegetable acids*. Henry's and Husband's magnesia are proprietary preparations of the heavy variety, differ little in their effects, and are rather to be preferred to that which is ordinarily sold as magnesia, on account of the great care taken in their preparation. The dose of magnesia for an adult is 40 grains when a cathartic effect is sought for, and from 5 to 10 grains as an antacid.

Magnesium carbonate, *magnesii carbonas* (U. S. Ph.), *magnesium carbonicum* (Ger. Ph.), occurs in two forms: the light, *magnesii carbonas levis* (Br. Ph.), and the heavy, *magnesii carbonas ponderosa* (Br. Ph.), which differ from each other in their physical properties, but are otherwise identical. The effects of magnesium carbonate are similar to those of magnesia, but nearly three times as large doses are required. It possesses the disadvantage of being apt to give rise to flatulence on account of the carbonic-acid gas it yields when in contact with the gastric juice. When finely powdered it is sometimes used as a *dentifrice*, but lacks the polishing properties of chalk, and is used in pharmacy to assist in the solution of the essential oils in water, etc., and to aid in the manipulation of such bodies as copaiba. It may also be used as a *dusting powder*, and enters into the composition of a number of effervescing laxative and refrigerant preparations.

The *liquor magnesii carbonatis* of the Br. Ph., or fluid magnesia, contains about 10 grains of the carbonate to the ounce, and is nothing more than a solution of it in carbonic-acid water. It possesses no particular advantages over the dry salt, and is, moreover, of a somewhat bitter taste. Essentially the same preparation, but a little less elegant in appearance, may be made by adding the carbonate to ordinary soda water. The dose of the official solution is from 1 to 2 fl. oz. Dewees's carminative, *mistura magnesiæ et asafœtidæ* (U. S. Ph., 1880), contains 5 parts of magnesium carbonate, 7 parts of tincture of asafœtida, 1 part of laudanum, 10 parts of sugar, and enough water to make 100 parts. In doses of from 15 drops to 1 fl. drachm, it is a useful carminative in *colic*.

[The *pulvis magnesiæ cum rheo* of the Ger. Ph. is essentially the same as the *pulvis rhei compositus* of the U. S. and Br. Ph's., except that it contains magnesium carbonate instead of magnesia (see under RHUBARB). The dose as an *antacid* and *laxative* is from 20 to 60 grains for an adult; from 5 to 10 grains for a child from two to five years old.]

Magnesium borocitrate has been highly recommended as a solvent of uric-acid urinary calculi, and may be prepared by combining the carbonate with citric acid and borax. While hardly to be regarded as a definite chemical compound, it is useful in many cases.

Magnesium chloride is a highly deliquescent salt, used largely in various pharmaceutical and chemical processes as a desiccator. It has been suggested as a *purgative*, in ½-oz. doses, and is said to promote the secretion of bile.

Magnesium citrate.—Solution of magnesium citrate, *liquor magnesii citratis* (U. S. Ph., Br. Ph.), is an agreeable *cathartic*, particularly grateful to the stomach, and is very largely employed after excesses in eating or drinking. It causes the passage of fæculent stools, but, on account of some unknown differences in the methods of its preparation, at times fails of action and at others purges violently. It is therefore a rather unsafe preparation for use by delicate persons or those affected with debilitating diseases. About 12 fl. oz. is the ordinary cathartic dose; 6 fl. oz. will usually act as a laxative. It may be used as a *diuretic* and *refrigerant*, in the *febriculæ of childhood*, in doses of from ½ to 1 fl. oz.

Effervescent magnesium citrate, *magnesii citras effervescens* (U. S. Ph.), *magnesium citricum effervescens* (Ger. Ph.), is one of the granular effervescent preparations which may be substituted for the official solution of magnesium citrite, but contains less uncombined acid, is less agreeable, and is by no means so efficient, but has the advantages of portability and ready preparation for administration. It may be given in doses of from 1 to 4 teaspoonfuls, dissolved in a tumblerful of water, and the solution taken while effervescing.

Magnesium salicylate has been used in *typhoid* and other *fevers* in drachm doses. It

depends upon the salicylic acid for its virtues.

Magnesium silicate, or *meerschaum*, is slightly *astringent* and has been employed as a substitute for bismuth.

Magnesium sulphate, or Epsom salt, *magnesii sulphas* (U. S. Ph., Br. Ph.), *magnesium sulfuricum* (Ger. Ph.), is a *cathartic* which acts promptly without giving rise to nausea or griping, produces watery stools, and is rarely rejected by sensitive stomachs. In doses not sufficient to produce catharsis it is *refrigerant* and slightly *diuretic*. It is a most useful cathartic in febrile states, colic, and other conditions when a free movement of the bowels without any secondary depressing effects is desired. In the early stages of *dysentery*, before there are any very marked changes in the intestinal mucous membrane, there is scarcely any remedy which can be regarded as of equal value; 2-drachm doses, dissolved in a wineglassful of water, with a few drops of dilute sulphuric acid, should be given every hour until it is evident that complete evacuation of fæcal matters has taken place.

An average cathartic dose is about 1 oz., but it is rather better to give it in divided doses, as mentioned in connection with the treatment of dysentery. It may be conveniently administered in lemonade or lemon-flavoured soda water. Its objectionable taste may be removed by boiling it with freshly roasted coffee.

[Dried magnesium sulphate, *magnesium sulfuricum siccum* (Ger. Ph.), is ordered to be dispensed in Germany when magnesium sulphate is prescribed as an ingredient of a compound powder. The dose of it is about a third of that of the ordinary sulphate.

The *enema magnesii sulphatis* of the Br. Ph. is a purgative enema of 1 oz. of magnesium sulphate, 1 fl. oz. of olive oil, and 15 fl. oz. of mucilage of starch.]—Russell H. Nevins.

MAGNOLIA.—The bark of the *Magnolia glauca*, the sweet bay or swamp sassafras, that of *Magnolia acuminata*, the cucumber tree, that of *Magnolia umbrella*, the umbrella tree, that of *Magnolia grandiflora*, and that of *Magnolia macrophylla*, all trees and shrubs of the Eastern and Southern United States, possess the same properties, and are all included under this head. The bark of several of the species mentioned was official at one time in the U. S. Ph., but, on account of its virtues not being very well marked, has been dropped from it. A number of other species furnish a bark which is probably of equal value, but little used beyond the district in which the trees are found. A hot infusion of from 1 to 2 oz. is used to a certain extent in domestic medicine in the treatment of *colds*, *rheumatism*, and *gout*, on account of its diaphoretic properties. The cold infusion has slight *tonic* and *bitter* qualities, but the bark itself, in doses of from 30 to 60 grains, or an extemporaneous tincture made by macerating the bark in brandy or whisky is preferable. The green fruit of the *Magnolia acuminata*, treated in the same manner, is in good local repute for the treatment of *intermittent fevers* and *rheumatism*. From the leaves of *Magnolia glauca* an essential oil is obtained which closely resembles oil of anise. The trees are believed to have somewhat similar effects in counteracting malarial influences, as the eucalyptus. No ill effects result from large doses of these barks, and in localities where more valuable drugs are not at hand they may be used with some advantage in the conditions noted.—Russell H. Nevins.

MALAKIN.—This is the trade name of salicylidene paraphenetidine,

$$C_6H_4\begin{matrix}\diagup OC_2H_5 \\ \diagdown N - \underset{\displaystyle H}{\underset{|}{C}} - C_6H_4OH\end{matrix}$$

(Cerna). It occurs in the form of fine, light-yellow acicular crystals of a somewhat bitter taste, insoluble in water, sparingly soluble in cold alcohol, somewhat freely soluble in hot alcohol. It was introduced into medicine as a substitute for salicylic acid and the salicylates as being milder in its action. Dr. Robert Abernethy (*Edinb. Med. Jour.*, Feb., 1895) says that in the presence of dilute mineral acids it is decomposed into salicylic aldehyde and paraphenetidine. This decomposition takes place in the stomach, and the salicylic aldehyde, on being absorbed, is, according to Schmiedeberg, oxidized into salicylic acid in the tissues of the body and may be recognised in the urine. Dr. Abernethy gives the following case in detail, as it illustrates, he says, a troublesome condition occasionally met with in protracted cases of *rheumatic fever*: The patient, a woman twenty-nine years old, was admitted into the hospital on May 12th. A few days before she had had a chill with fever and pain in the joints, beginning in the left thumb and soon spreading to nearly every joint in the body. The signs were typical of a severe attack of acute rheumatism, with copious sour perspiration. The temperature was 101° F., and the pulse was 90. There were severe pain and swelling of various joints, particularly the knees and wrists. At first salicin was given in doses of 30 grains every two hours, and this was continued until the 17th, without, however, having a very marked controlling effect on the symptoms. The pulse and the breathing became accelerated, and some consolidation was noticed at the base of the left lung. The temperature varied between 99° and 102°. Quinine sulphate was substituted for the salicin, but with no effect on the temperature, although the signs in the left lung entirely disappeared. The patient lost a good deal of flesh, and paraldehyde was administered in order to induce sleep. The joints began to improve, and on June 29th the right knee was the only one affected, but there was still a good deal of effusion in it. On this date, however, the patient had a sudden very severe rigor, and the temperature rose to 104·8°; there was copious sweating, with severe pain in the right knee joint. The ice-pack was applied and brandy given, with the result that the temperature fell to 101·8° in five hours. Fever persisted, however, and the patient continued to lose flesh. No albumin appeared in

the urine, and the articular swelling began to disappear under blistering and rest. On July 7th the temperature rose again to 105·4°, with a rigor, but fell rapidly after sponging with ice water and the administration of stimulants. These pyrexial attacks occurred from time to time, and toward the end of July the temperature curve assumed a more zigzag course instead of its previous continued type. During the first part of August several attacks occurred, and after the 12th they took place almost daily. On the 28th of August Dr. Abernethy began the use of malakin and gave it to the patient in doses of 15 grains three times a day, and at once there was a cessation of all *pyrexia;* the temperature became normal and remained so until the patient left the hospital. She was then quite well, fairly strong, and able to walk about the ward, and nothing remained but a faint systolic bruit accompanying, but not replacing, the first cardiac sound.

Dr. Abernethy was so convinced of the good effects of the drug in this case, after other antipyretics had failed, that he has given it since in a good many cases of pyrexia due to various causes; among others, a case of rheumatic fever with advanced mitral disease, in which it controlled the symptoms admirably without apparently causing any considerable depression. In two cases of *croupous pneumonia* occurring in children he has used the drug, and it seemed to have a beneficial effect, both children making remarkably good and speedy recoveries. Such results, he says, encourage him to make further trials with the drug in cases of pyrexia in which either phenacetine or the salicylic group has been found useful, but especially the latter, as its use seems to be attended with a minimum of the bad effects sometimes seen under the administration of those drugs.

Malakin has been employed as an *analgetic* in *neuralgia*, but has not generally proved very efficient except in cases of moderate severity.

MALE FERN.—See Aspidium.

MALLEIN, *malleinum*, is a substance prepared from artificial cultures of the glanders bacillus (*Bacillus mallei*). It is analogous to tuberculin and is used for the diagnosis of *glanders* in equine animals. When a proper dose is injected into the subcutaneous connective tissue of animals affected with this disease there follows an increase of the bodily temperature of 2·5° F. or more, with a warm and sensitive swelling from three to eight inches in diameter at the point of inoculation. With healthy animals such an injection causes, as a rule, either no increase or only a slight increase of the bodily temperature and little, if any, local swelling.

Mallein was first prepared by scraping the surface growth from potato cultures of the *Bacillus mallei*, mixing it with water, sterilizing by heating to 100° C., filtering, and adding a variable quantity of a 2-per-cent. solution of carbolic acid. The method now generally adopted is to cultivate the bacillus from two to eight weeks in peptonized bouillon to which has been added from 4·5 to 5 per cent. of glycerin. The cultures are sterilized by heating for two hours to 100° C., filtered through the Pasteur filter, and evaporated or diluted with glycerin according to the concentration desired. The active principle may be obtained in a purer condition by precipitating the mallein from the sterilized and filtered culture liquid with absolute alcohol. This precipitate may be redissolved in a mixture of glycerin and distilled water or in a weaker solution of carbolic acid, or it may be preserved in a dried condition and dissolved when about to be used.

The proper method of testing a suspicious animal is to take the temperature (*per rectum*) every two or three hours on the day preceding the injection, in order to determine the normal temperature of the individual. The mallein should be injected early on the following morning, and the temperature taken every two hours during the day. If the animal is glandered, the temperature may begin to rise within three or four hours, and the maximum is reached in from eight to twelve hours. The injection should be made on the side of the neck, in order that the local swelling may be readily observed. This begins in from two to four hours after the injection, and may continue to enlarge for two or three days. It usually remains at least two days. With healthy horses, if a slight swelling results, it disappears within twenty-four hours. The dose of mallein from different sources necessarily varies on account of the different methods used in its preparation. The mallein of the United States Bureau of Animal Industry is prepared from cultures in acid peptonized bouillon containing 5 per cent. of glycerin. These are sterilized, filtered, and diluted with an equal volume of glycerin. The dose of this mallein is one cubic centimetre.

[According to M. Jules Rochard (*Union méd.*, Oct. 26, 1895), the following official instructions have been issued in regard to the use of mallein in the French army: All the animals kept in one stable should be subjected to injections of mallein. After the test they should be divided into three groups: The first to be composed of those which, not having shown any organic or thermic reaction, may be considered as healthy. These animals may remain in the stable and take part in the work of the service. They should, however, be subjected to another test with the mallein. The second group is to be composed of animals the temperature of which is elevated more than one degree, organic reaction being more or less completely absent. They should be considered as suspicious subjects, isolated, and again subjected to the test; if any among them react completely, they should be passed immediately into the third group. When two injections have been administered successively without causing reaction, the animals may be restored to the service. The third group is to be formed of animals which have reacted completely—for example, by persistent and extensive œdema, dulness, prostration, trembling, loss of appetite, and hyperthermia, the minimum being 3·2° F. above the normal. Those of this class that continue to react in this

manner after two injections of mallein administered at an interval of a month should be killed; those that show no thermic or organic reaction after the two injections may be kept in the service.]—D. E. Salmon.

MALLOW.—See Marshmallow.

MALT, under the title of *maltum*, was formerly an official preparation, but was dropped from the U. S. *Pharmacopœia* of 1890. It is formed from the cereal grains by the process of germination. As the base of beer, ale, and other brewed liquors, it is used in enormous quantities. For this purpose it has been employed from very ancient times; its use as a medicinal agent is modern. Nearly all the cereals have been used, but barley is so universally employed that, unless otherwise stated, malt is understood to be the product of that grain.

In its preparation live and well-ripened grain is thoroughly soaked in water until it has become soft. It is next placed in receptacles where an elevated temperature is maintained for several days. It is then placed in heaps, where it is allowed to remain until the germination has so far proceeded that the plumule has grown to about half the length of the seed. When this process has reached the proper point the grain is kept subjected to a high temperature until it is perfectly dry. This dry product is known as malt. Its colour depends upon the degreee of heat used and the length of time it is applied, a low temperature producing pale or amber malt. The malt from which porter is made is subjected to a high temperature, being almost roasted. Only pale or amber malts are used in medicine. Malt has an agreeable odour and a sweet taste, and readily forms an infusion with water. During the process of malting there is an increase of about 9 per cent. in volume, but a decrease of 20 per cent. in weight.

The composition of malt differs with the quality of the grain employed and the length of time the various processes are carried on. The albumins of the original grain are rendered softer and more spongy, but the chief changes occur in the starch. By a wise provision of Nature the material supplied in the grain for the nourishment of the germ from which the new plant is to be developed is stored in the form of insoluble starch, which maintains its integrity indefinitely. It is combined with a ferment known as *diastase*, which under the action of heat and moisture converts the starch into dextrin and sugar, which are soluble bodies adapted to the nourishment of the embryo. In the process of malting germination is allowed to continue until as large a proportion of starch has been converted into maltose as possible, but is checked before any considerable portion has been consumed by the plant in its growth. The sugar resulting from the action of diastase is allied to other sugars and is known as maltose. It readily undergoes fermentation, and, owing to its peculiar combination with the ferment, is admirably adapted to the purpose of brewing. The following, from Hager, shows the composition of ordinary barley malt: Starch, 68 per cent.; dextrin, 15 per cent.; maltose, 15 per cent.; gluten, 1 per cent.; diastase, 1 to 2 per cent.

Maltose is a peculiar sugar resulting from the action of diastase upon starch. It is soluble in water and in alcohol, crystallizes with difficulty, and has the formula $C_{12}H_{22}O_{11},H_2O$. It is closely allied to glucose.

Diastase, or *maltin*, is the peculiar ferment formed by the cereal grains during germination. It is closely allied to the ptyalin of the saliva and also to the pancreatic diastase. These ferments are apparently identical and act upon starch in the same way. Upon raw starch their action is slow, but upon cooked starch it is extremely rapid. The chemical process is that of hydration. The first stage of the process is that of liquefying the starch, which is then converted into dextrin and finally into maltose. Like ptyalin, diastase acts best in a neutral medium. In an alkaline medium its action is slow, while an acid, even if weak, destroys it entirely.

Malt is converted by the process of brewing into beer, ale, or porter. It is also converted into the mash from which whisky is distilled. For medicinal purposes a simple infusion of malt may be used or a fluid extract. The former has been largely used during recent years in the preparation of certain infant foods. These foods are made of various cereals, with or without the addition of milk, the malt being added to convert the starch more or less completely into sugar and dextrin. One of the so-called Liebig foods may be made as follows: Take of ground malt, ½ oz.; white flour, ½ oz.; potassium bicarbonate, 7½ grains; water, 1 oz.; milk, 5 oz. Warm the mixture and stir it until it becomes thick; remove it from the fire and stir it for five minutes; replace it on the fire, but remove it as soon as it becomes again thick. It will gradually become thin and sweet, when it should be boiled and strained. The extract of malt may sometimes be added to advantage to the food of infants who suffer from *weak digestion* or whose digestion has been impaired by acute disease.

As a medicine, malt is employed almost exclusively in the form of extract. It is now rarely made by the dispensing chemist, but its manufacture is in the hands of large firms, which produce it in enormous quantities. It occurs as a sweet, brown liquid of the consistence of honey, and of a taste not unpleasant to most palates. Its physiological action is not wholly clear. Strictly scientific observations are not numerous, but they seem to show that many of the extreme statements made for the preparation are not well founded. It has been lauded as a digestive agent and as a reconstructive. With reference to the first allegation, it must be remembered that diastase acts imperfectly in an alkaline medium and is destroyed by an acid. It must act very imperfectly, therefore, in the stomach—an organ in which the secretions are sharply acid. It is, in fact, destroyed in that organ, and is

inert even if it reaches the alkaline contents of the duodenum. As a digestive ferment, it can only be used effectively for the predigestion of starchy foods. When it is administered by the stomach, all action in most cases ceases at once. It is not impossible that it may, in certain conditions of impaired digestion in which the acid of the stomach has been reduced, prove of value as a digestive agent, but such conditions are rare. Several other digestive agents are certainly more efficient and reliable.

It does not follow from these facts, however, that malt is valueless as a reconstructive agent. Maltose, like all sugars, has decided fat-producing qualities. It is a clinical fact that extract of malt is sometimes tolerated by the most irritable stomachs. It is frequently retained when cod-liver oil is not tolerated, and in the *wasting diseases* it sometimes proves a valuable substitute for that preparation. It proves most effective in cases of chronic debility and in the wasting diseases, especially *tuberculosis.* It not infrequently proves of more direct value than the malt liquors. It sometimes aids materially in nourishing weak and anæmic children, who, as a rule, take the preparation very well. It may be spread on bread, alone or mixed with syrup. It is largely used in combination with cod-liver oil, as it readily emulsifies that agent. The numerous trade preparations combined with various drugs are in most instances unscientific and unsatisfactory. The preparations of so-called liquid malt are commonly little more than beer, containing little or no diastase. The alcoholic preparations of malt have long enjoyed a reputation of increasing the flow of milk in nursing mothers. That they increase the quantity of milk is undoubted, but the quality of such milk is frequently very poor. The extract of malt also has sometimes a distinct and undoubted effect of increasing the milk flow. The quality of the milk in such cases seems to be somewhat better than that produced by the alcoholic preparations. While malt has a certain distinctive value as a food and reconstructive, as a digestive agent its power has probably been overestimated. (Cf. TAKA-DIASTASE.)—FLOYD M. CRANDALL.

MALTINE.—Maltin (see under MALT).

MALTO-CARNIS.—This remarkable name is that of an English proprietary food preparation described in the *Dublin Journal of Medical Science* for January, 1896, as "a clever combination of extract of malt and cocoa with uncooked beef-juice."

MALTOSE.—See under MALT.

MALVA.—See MARSHMALLOW.

MANACA is a portion of the root and stem of *Brunfelsia hopiana*, a plant growing in Brazil. The drug is said to contain an alkaloid called *manacine*, and this is described as a yellow, hygroscopic powder of somewhat bitter taste. Experimental evidence as to its physiological action is scanty, but the drug is said to act particularly upon the spinal cord, at first stimulating its motor centres and subsequently depressing them. The cardiac and respiratory centres also are depressed by it, but glandular action throughout the body is much increased, especially that of the kidneys. The symptoms of its physiological action in man are a sense of constriction in the head, nausea, and pronounced diaphoresis, and the occurrence of these should ordinarily limit its further administration. In large doses it causes weakness and loose, greenish evacuations. In very large doses it is an acrid poison.

Manaea is used in Brazil as a *purgative*, *diuretic*, *emmenagogue*, and *alterative*, but with us it has but a very limited employment. It is said to be an efficient alterative in *chronic* and *subacute rheumatism*, in *rheumatic neuralgia*, in *scrofula*, and in *late syphilis*. *Muscular rheumatism* also is thought to be benefited by it, and *acute articular rheumatism* also if the remedy is pushed until its physiological effects are seen. The dose of powdered manaca is from 5 to 20 grains. The fluid extract (not official) is a more desirable form for administration. The dose of this is from 10 to 30 drops, and it may be given three times daily.

HENRY A. GRIFFIN.

MANGANESE, *manganum*, *manganesium*, is a metallic element of a molecular weight of 86·72. In Nature it occurs chiefly in the form of manganese dioxide (MnO_2) or the black oxide of manganese in amorphous crystals of a dull-gray or black colour. It is insoluble in water and the weak acids, but it dissolves readily in hot hydrochloric acid, giving off chlorine gas. The metal manganum was first isolated in 1774, by Gahn, although its existence had been previously suspected. The black oxide of manganese was early supposed to have therapeutic qualities similar to those of iron, but this theory has so long been disproved that the metal is almost obsolete in the treatment of chlorosis, anæmia, and the various cachexias. Gahn (*Archiv f. exper. Path. und Pharm.*, xviii, 20) proved that, taken internally, manganese was probably not taken up by the red corpuscles of the blood, and that its entrance into the circulation was doubtful. It is not absorbed from the gastric and intestinal walls and is excreted in the fæces. The experiments of Garrod (*Med. Times and Gazette*, Feb. 27, 1864) proved conclusively that manganese was useless in the treatment of anæmia and chlorosis.

The black oxide of manganese, *mangani dioxidum* (U. S. Ph.), *manganesii oxidum nigrum* (Br. Ph.), was long in favour in practice for *amenorrhœa*, and the most absurd statements were made in its behalf. It mattered little what the cause of the cessation of menstruation might be, except pregnancy, manganese would restore the function alike in the anæmic and in the plethoric, the married and the unmarried. The suspension of the catamenial flow during lactation was even supposed to be interrupted by the administration of the metal. At the present day, however, it is doubtful if this therapeutic measure is longer considered specific for interrupted menses. The observation of thousands of cases has con-

signed the drug to oblivion so far as its gynæcological value is concerned.

In severe cases of *gastrodynia* the oxide of manganese has been stated to have the therapeutic value of the subnitrate of bismuth (*Glasgow Med. Jour.*, Jan., 1865). It forms an insoluble coating on the mucous surface of the stomach, given in doses of from 5 to 40 grains. In *gastralgia* from any cause, and in *pyrosis*, especially when there was pain after eating, Leand (*loc. cit.*) recommended manganese. He alleged for it all the advantages of bismuth, and said that it did not constipate like that drug.

Absorbed in large quantities as it is by the miners of the metal, manganese may act as a cumulative poison. The main symptom of this toxic condition is a staggering gait. It will rarely be met with in practice, since it occurs only in those who for a long time have taken small amounts into their systems.

The dose of the dioxide of manganese when administered for amenorrhœa or anæmia is from 1 to 3 grains, thrice daily. It is best given in pill form.

The other combinations of manganese which are occasionally used in medicine are the *sulphate*, *mangani sulphas* (U. S. Ph.), the *carbonate*, the *iodide*, the *lactate*, the *phosphate*, the *tannate*, the *tartrate*, the *salicylate*, the *oxalate*, and the *saccharate*. They are all poisonous in overdoses, and in small doses act as *sedatives* to the circulatory and nervous systems. These combinations do not, as was formerly believed, act as iron does in the human economy, but the testimony of experimenters shows their influence to be the reverse.

The *sulphate of manganese* is the most used of those enumerated. On animals it is known to have a *purgative* influence, acting as a *cholagogue*. In man the same effect is said to have been observed in doses of from 2 grains to 1 drachm. It has an irritating influence on the bowel, however, and is therefore not safe, its use being often accompanied by cardiac depression. In its taste and effect it resembles the sulphate of sodium. The sulphate has also been used in the form of an ointment (in the strength of 1 to 2 drachms to the ounce) in *glandular indurations* and in *painful joints*; but it can not equal other topical applications in its local beneficial effects.

The *carbonate of manganese* has been recommended as a topical application in *ulcers*, particularly those of *syphilitic* origin; but it has little value. Harmon, of Belgium, found that after its prolonged internal administration it improved the appetite and that the pulse was increased in force in *anæmia*.

The *iodide of manganese* has also been called into requisition for the treatment of *anæmia*. A special virtue attributed to this preparation is that it reduces the size of a spleen enlarged in the process of a prolonged fever.

In England and Scotland the *syrup of the phosphate of manganese* had formerly an extended use in the treatment of *chlorosis* and *anæmia*. It is now, however, almost obsolete.

When it was learned that manganese alone was unable to exert a chalybeate effect upon the body, it was decided to combine the metal with iron in some form. There are several syrups and liquors that contain the two elements, the most efficient, perhaps, being the *liquor ferri mangani peptonati*. This has caused, according to many recorded observations, marked improvement in cases of *amenorrhœa* associated with or dependent upon *anæmia* or *chlorosis*. Probably the manganese acts simply as an adjuvant to the iron or is inert, but sometimes striking results are obtained by its use. It is a pleasant aromatic drug, and may be given in doses of a drachm three or four times a day. It is especially indicated in *anæmia*, *chlorosis*, the *weakness* following *confinement*, and those cases of *amenorrhœa* which occur in young girls who have crossed the ocean. There is a *syrup of ferrous and manganous iodides* which is said to have the same therapeutic influence as the liquor just described.

The chief of all preparations of manganum used in medicine and surgery is the *permanganate of potassium*, $KMnO_4$, *potassii permanganas* (U. S. Ph., Br. Ph.), *kalium permanganicum* (Ger. Ph.). It occurs in dark purple or deep violet-red crystals with a bluish or greenish metallic lustre. It dissolves easily in cold, more easily in boiling water. A small proportion only of the salt gives a deep wine-red colour to a large quantity of water. When placed in contact with organic matter the permanganate of potassium gives up oxygen to the organic substances and is reduced to black oxide of manganese. *Mineral chameleon* was the name given to the mass when, in certain chemical reactions, the green permanganate underwent rapid changes of colour. It is through its oxidizing power that the permanganate of potassium becomes a *disinfectant*.

Pure potassium permanganate, placed upon a healthy skin, produces only a brown stain; on intact mucous surfaces it has no defined action, but on raw surfaces of the mucous membranes it induces burning and smarting. It has been frequently administered internally in large and in small doses; but doses of 2 grains have provoked symptoms of irritant poisoning, and a similar amount is recorded to have produced abortion. Its internal use has been recommended for *acute articular rheumatism*, for *diphtheria*, and for *diabetes*. It is very doubtful if any good result has ever been obtained from its use in any of these diseases. Ringer recommended it in doses of from 2 to 3 grains for *amenorrhœa* from any cause. Its use for this purpose was highly praised by Thomas, who pronounced it the most efficient of emmenagogues. It is quite probable that even Dr. Thomas has experienced a change of heart, however, for in the last edition of his book (*Diseases of Women*, Thomas and Mundé, Philadelphia, 1891) no mention is made of the permanganate of potassium or of any preparation of manganum in the chapter on Amenorrhœa. Mr. N. W. Davies (*Lancet*, June 8, 1889), in a review of uterine medicines, unhesitatingly denies the virtues of potassium permanganate as an emmenagogue, and his experience has been that of the majority of practitioners of

medicine and of gynæcologists; and, although one still occasionally reads of cures of amenorrhœa through the agency of this drug, it is more than likely that they are only coincidences. A good formula for its administration is this:

> Permanganate of potassium,
> Kaolin, of each............ 2 grains;
> Vaseline.................. q. s.
> Mix and make into a pill.

One such pill is to be taken thrice daily. No oxidizable substance can be used with the permanganate, as its union with it would cause combustion. The drug frequently causes depression on its internal administration, and it should be combined with some cardiac stimulant, such as caffeine or strychnine. In the future its use for cessation of the menses will undoubtedly be very limited, or it will be discarded altogether as we learn more of the causes which produce this symptom.

As a *topical application* the permanganate of potassium has a wide and satisfactory use. Its power of destroying evil smells is taken advantage of by applying it to *sloughing malignant growths*, particularly of the cervix uteri. In *ulcers* of any kind, in *caries of bones*, in *abscesses*, and in *gangrene* it proves an efficient and elegant wash. It may be applied with a brush or on compresses of gauze or lint, in the strength of from 3 to 10 grains to an ounce of water. In dilute solutions it has a stimulant action on the tissues. In extensive *burns* it is particularly appropriate in a solution of 3 grains to an ounce.

As a spray or gargle, in the proportion of 1 to 10,000, it is useful in *diphtheria* as a disinfectant and cleansing agent. It may be used in the same way in offensive *ozæna* and *otitis media purulenta*. In *acute amygdalitis* and in cases in which the breath is fœtid from the presence of *carious teeth*, a solution of 3 grains to an ounce will destroy the odour and act as a disinfectant. To remove the smell from the hands after dissecting or the performance of an autopsy, a solution of 1 to 8,000 is valuable. In similar proportions it is useful in removing the odour in *hyperidrosis* of the feet and of the *axillæ*. The stains produced upon the clothing by a solution of the salt can be removed by oxalic acid, lemon-juice, or a solution of the sulphate of iron.

Zühoff (*N. Y. Med. Jour.*, Oct. 2, 1886) recommends highly the use of this salt in *frostbite*. For this application a solution of 5 grains to the ounce is sufficiently strong.

The permanganate of potassium finds another field for local application in skin diseases. In a strength of from 1 to 2 per cent. it has been highly praised in certain forms of *eczema*, *impetigo*, and *prurigo*. Baths containing from 10 to 15 grains of the salt to a gallon of water have been used for the same purposes. On slowly granulating surfaces it produces a stimulating effect.

In profuse *leucorrhœa* from any cause or where the *lochia* have a bad odour, a 2- to 5-per-cent. solution of the salt may be satisfactorily used as a disinfecting douche.

Keyes recommends the permanganate of potassium in a strength of 1 to 2 per cent. as an injection in *subacute gonorrhœa;* and Ultzmann's well-known treatment of *chronic gonorrhœal urethritis*, especially of posterior urethritis, scarcely needs mention. He begins with a hot solution of 1 to 20,000, and injects the fluid into the bladder, from which it is immediately ejected. The strength is gradually increased until that of 1 to 1,000 is reached, by which time a cure is often accomplished.

The permanganate has been boasted as a cure of *snake-bite poisoning*, and probably acts by destroying the constitution of the poison by oxidizing it. To be effective, however, it must be employed immediately after the receipt of the wound. If applied to the site of infection later it is valueless. As an antidote to *phosphorus poisoning*, Hagnos, of Buda-Pest (*Gyògyaszat*, 1892, No. 2), has found it efficacious. He washed out the stomach in the manner usual in phosphorus poisoning and then introduced 15 fl. oz. of a $\frac{1}{10}$-per-cent. solution of the permanganate and left it there. The patient recovered.

Dr. William Moor, of New York (*Med. Record*, Feb. 17, 1894), has proclaimed potassium permanganate as an antidote in *morphine poisoning*. He took 3 grains of morphine and followed it at once by a dose of the permanganate. No narcotic effects of the morphine were noticed. Experimentally he was equally successful. Dr. H. C. Wood (*Univ. Med. Mag.*, vi, p. 747), after a series of similar experiments, concludes: "Permanganate of potash given by mouth directly after poisoning [by morphine] is a valuable but not a perfect antidote to the morphine salts—an antidote, however, which should not be relied upon to the exclusion of emptying the stomach by medicinal or mechanical means."

In 1885 Sternberg (*Med. News*, Jan. 10) suggested the use of a solution of the salt as a *germicide* and *disinfectant*, and this has been put into practical use by Dr. H. A. Kelly, of Baltimore. After the usual scrubbing of the hands and arms they are immersed in a saturated solution of the potassium permanganate until they become mahogany-red. They are decolourized by a second immersion in a saturated solution of oxalic acid and again washed in sterilized water. The occasional subsequent itching of the skin may be allayed by the use of limewater. This method of disinfection is in use in a number of American clinics.

Contaminated water may be purified by the addition drop by drop of a solution of the salt until the pink colour ceases to be destroyed after twenty-four hours. The decanted water will be free from organic material.

SAMUEL M. BRICKNER.

MANGO, the fruit of *Mangifera indica*, is an Eastern tropical fruit having a resinous juice which has some local repute as a remedy for *syphilis*. The seeds are reputed *anthelminthic*, the pulp is considered *tonic* and *antiscorbutic*, and all parts are esteemed as *astringent* and *hæmostatic*.—RUSSELL H. NEVINS.

MANNITOL HEXANITRATE. See the bracketed section under NITRIC ACID.

MARANTA.—See ARROWROOT.

MANNA is a concrete saccharine exudation that is obtained by making transverse incisions in the branches of *Fraxinus ornus*, the manna or flowering ash of southern Italy, Sicily, and Asia Minor. A somewhat similar substance may be obtained from the larch, the oak, the tamarisk, and the eucalyptus.

Manna occurs in commerce in small, friable, yellowish- or brownish-white fragments of variable size, that have a sweet odour and taste. It contains from 70 to 80 per cent. of *mannite*, $C_6H_{14}O_6$, a saccharine substance consisting of a mixture of cane sugar and levulose, dextrin, a glucoside, *fraxin*, $C_{16}H_{18}O_{10}$, which resembles æsculin, a nauseous principle, and mucilage. Mannite occurs in white, acicular, odourless crystals, that have a sweet taste and are slightly soluble in water and in warm alcohol. Fraxin occurs in colourless prismatic crystals that have a faintly astringent taste.

Manna is a *laxative* that sometimes occasions flatulence and colic. It may be administered in its natural condition or dissolved in water, milk, or some aromatic infusion. The dose for children is from 1 to 4 drachms; for an adult, from 1 to 1½ oz.

[Syrup of manna, *syrupus mannæ* (N. F.), *sirupus mannæ* (Ger. Ph.), may be used as a vehicle for laxative medicines.]

SAMUEL T. ARMSTRONG.

MARROL.—This is an English dietetic preparation consisting of the bone-marrow of the ox with hopped malt extract. The dose for an adult is a tablespoonful; that for infants and children, from ½ to 1 teaspoonful, plain or in milk (*Dublin Jour. of Med. Sci.*, May, 1895). The indications for the use of marrol are the same as for that of marrow.

MARROW.—In the *Lancet* for March 10, 1894, Dr. J. Dixon Mann, of Manchester, having assumed that the red marrow of the bones was probably the chief agent in promoting the development of red blood-corpuscles, says that he was led to suppose that an extract of this substance, introduced into the system in cases of *anæmia*, might act as a stimulant to the formative process and increase the rate of production of the red corpuscles. He remarks that in adult animals, such as the ox, the red marrow is limited to the large bones of the trunk, the thick bones of the skull, and the heads of the long bones, while in young animals, such as the calf, it is more abundant and may be found in the shafts of the long bones as well as in other bones named. As the tissue-forming power is more active in young animals than in old ones, the bones of the former are preferable, he thinks, as a source of marrow extract. To prepare the extract, the heads of the long bones, obtained from animals freshly killed, together with other portions of bone which contain red marrow, are broken into small pieces and digested in glycerin with frequent agitation. When the extraction is complete, for which several days are required, the extract is filtered and is then ready for use. It is of a red or reddish-brown colour, and has no unpleasant taste or odour. It may be given in teaspoonful doses once or twice a day, either by itself or spread between thin slices of bread.

The first case in which Dr. Mann tried the extract was that of a little boy who was a subject of hæmophilia. He had been in a hospital repeatedly for attacks of hæmorrhage. On each occasion the bleeding had ceased, but the boy had never lost the pallor of pronounced anæmia, although he had been treated with iron, arsenic, cod-liver oil, and all kinds of appropriate nourishment. On the last occasion of his having been admitted the red corpuscles had been counted after the hæmorrhage had subsided, and been found to be 3,800,000 to the cubic millimetre. Then, on the 13th of September, 1893, the patient was put upon the use of marrow extract without any other treatment, and after an interval of three weeks the corpuscles were counted again; they then numbered 4,190,000, and a month later they had reached 4,400,000. Coincidently with this increase, says Dr. Mann, there was a marvelous improvement in the child's appearance. His face acquired a healthy colour that had never been observed previously during his visits to the hospital.

In the second case, that of a girl twenty years old, with long-standing anæmia, the corpuscles numbered 3,700,000 to the cubic millimetre. After she had taken the marrow extract for three weeks they increased to 4,000,000, and then she left the hospital. In another anæmic girl the increase in nine weeks was from 1,350,000 to 3,680,000. A man was admitted for profuse hæmatemesis, and after the bleeding ceased the red corpuscles were found to be reduced to 1,070,000 to the cubic millimetre. He was put on the use of marrow extract without any other treatment, and when the corpuscles were next counted, on the fifteenth day, they numbered 3,050,000.

In April, 1894, Dr. Thomas R. Fraser, of Edinburgh, presented before the Eleventh International Medical Congress, held in Rome, a communication on the use of bone-marrow in the treatment of *pernicious anæmia*. An abstract of Dr. Fraser's communication was published in the *British Medical Journal* for June 2, 1894. Only one case formed the basis of the paper, that of a gardener, sixty years old, whose symptoms had been frequent vomiting and diarrhœa, œdema of the feet and ankles, moderate and irregular pyrexia, dimness of vision, retinal hæmorrhages, loss of appetite, dyspnœa, and at last complete prostration. His illness had existed for about four months when he came under Dr. Fraser's care at the Edinburgh Royal Infirmary. Some of the remedies usually employed in pernicious anæmia were given at first, and only after they had failed was marrow resorted to. The uncooked bone-marrow of the ox was given by the mouth in daily amounts of 3 oz.; the man was still taking arsenic and iron. Improvement began almost immediately, and at the end of three weeks the number of red corpuscles, which had fallen to 843,000 to the cubic millimetre of blood, rose to 1,800,000, and the hæmoglobin, which had been only 18 per cent., increased to 35 per cent. In the subse-

quent treatment, covering a period of more than three months, the use of ox and calf marrow was continued, but salol was administered in addition. At the time of the report the red corpuscles had increased to 4,000,000, and the hæmoglobin to 85 per cent. Subsequently the use of salol, which, Dr. Fraser admitted, had somewhat obscured the demonstration of the curative action of the marrow, was discontinued, and for four weeks the patient was treated with marrow alone; his improvement was fully maintained. "The frequent failure of therapeutic measures in pernicious anæmia," says Dr. Fraser, "confers an interest upon any remedy which appears capable of controlling this malignant disease, even although the evidence is derived from one case only, and notwithstanding the circumstances that temporary improvement occasionally, though very rarely, appears to occur spontaneously. The facts now stated appear to justify the hope that bone-marrow will be found to have a remedial value in some at least of the cases of pernicious anæmia."

Dr. Allan McLane Hamilton (*N. Y. Med. Jour.*, Jan. 12, 1895), has used a preparation which he calls *medullary glyceride*, made by macerating 1½ lb. of comminuted calves' ribs for several days in a quart of glycerin, with frequent stirring, and finally straining through cheese cloth. It is given in doses of from 1 to 4 teaspoonfuls three times a day, with a few drops of essence of peppermint. The cases selected by Dr. Hamilton for treatment with bone-marrow presented varying forms of red-corpuscle poverty (*oligocythæmia*) and diminution of hæmoglobin (*oligochromæmia*), most of which were obstinate and had resisted arsenic, iron, manganese, and other remedies, and in every instance preliminary examinations of a definite kind were made, the red corpuscles being counted by the Thoma-Zeiss apparatus, and the hæmoglobin estimated by the instruments of Fleischl, Gowers, and Henocque. No count was made of the white corpuscles. The micrometric counts made before, during, and after treatment convinced him that a great multiplication of red corpuscles was possible, the number greatly exceeding the fixed normal standard in some instances, and the daily increase being much more extensive than had been admitted by those observers who have detected a maximum increase of 20,000 or 30,000 *per diem* after excessive hæmorrhage. In two cases the ordinary limit was passed by a million or more, a result which appeared incredible at first, but was proved in a variety of ways, every precaution against error being taken. Dr. Hamilton mentions Dr. W. Gilman Thompson as having told him of an experience that had convinced him that both corpuscles and hæmoglobin might exist in very much greater quantities than had been supposed to be possible. In two or three cases poikilocytosis, or irregularity in the shape of the corpuscles, had been present.

It is, Dr. Hamilton thinks, reasonable to ascribe this rapid and extraordinary increase to the direct influence of the medullary ex-extract; and the immediate improvement in the state of the blood and subsidence of symptoms, which certainly go together, are no less wonderful, he says, than improvement that follows the use of thyreoidal extract in myxœdema, though the gain is more permanent than in the latter.

Dr. J. S. Billings, Jr. (*Johns Hopkins Hosp. Bull.*, Nov., 1894), reports having employed bone-marrow extract in four cases, two of pernicious anæmia and two of chlorosis. The results in the former disease were unsatisfactory, and he ascribes the benefits following the use of marrow in the other cases to the iron contained in it—a conclusion which, says Dr. Hamilton, does not seem to be borne out in cases in which the red corpuscles are multiplied without any corresponding increase in the hæmoglobin.

As to the merits of the marrow from the different bones, Dr. Hamilton says that his best results were obtained with the red marrow contained in the small bones, notably the ribs of the young animal. The coarse marrow from the long bones, he remarks, contains a great deal of fat, and while this is, of course, a beneficial nutrient, it would seem that the specific virtues of the agent exist in greater degree in the finer medullary substance. The glycerides were administered alone and together in cases where no other remedy was given, and the good effects were, as a rule, apparent within a few days, and lasted after the discontinuance of the treatment. In but one case were they not apparent.

In cases in which *anæmic headache* was the prominent feature the effects of the marrow were found by Dr. Hamilton to be very decided. Two brominized epileptics were decidedly benefited, and this treatment, says Dr. Hamilton, must commend itself when iron in such cases is apt to produce cerebral congestion and an increase of the fits.

On the whole, the experience that has been recorded during the short period that bone-marrow has been in use as a remedy decidedly favours the conclusion that it is a valuable agent in the treatment of anæmic conditions.

MARRUBIUM.—See Horehound.

MARSHMALLOW, *althæa* (U. S. Ph.), *radix althææ* (Ger. Ph.), is the root of *Althæa officinalis*, a perennial plant that is found on the borders of salt marshes in this country and Europe. While all parts of the plant contain the characteristic mucilage, the roots only, which are collected in autumn, are official. The root contains a small percentage of *asparagin.*

A syrup, *syrupus althææ* (U. S. Ph.), *sirupus althææ* (Ger. Ph.), is given in doses of from 1 fl. drachm to ½ fl. oz.

The powdered root may be used as a poultice in all conditions in which flaxseed is indicated. It may be used in combination with simple ointment as a soothing application to *chafed* or *excoriated skin.* Internally, it is a *demulcent* and mild *diuretic*, and may be administered, in an infusion or decoction, for *irritation* and *inflammation of the bronchial mucous membrane*, and in the *renal complica-*

tions associated with some of the exanthemata in children.—Samuel T. Armstrong.

MASSAGE.—"Massage is a scientific mode of treating certain forms of disease by systematic manipulation" (Murrell). Treatment by various forms of rubbing, kneading, and tapping is almost or quite as old as the art of healing itself, but the last twenty-five years have witnessed such an extraordinary revival of interest in the application of massage in medical practice that its literature has assumed truly formidable proportions. Massage consists of certain definite manipulations, selected for their physiological effect, among which are *effleurage*, or stroking; *pétrissage*, or kneading; *massage à frictions*; and *tapotement*, or percussion; to these are often added vibrations, shakings, and other movements. Remedial exercises, particularly the passive and duplicated Swedish movements, are often and properly employed as auxiliary to massage, but differ widely from it and are not included under that term in this article. "Massage is always manipulation, but manipulation is not always massage." Ordinary or extraordinary rubbing furnished by amateurs and by many professional manipulators and self-styled masseurs and masseuses is not massage in any accurate sense.

Ordinary manual friction of the skin, however, is instinctively used to quicken the circulation in many emergencies and has its legitimate place as a remedial measure. If a child bumps his head, he rubs the spot to allay the pain. If the extremities are cold from faintness or other cause, vigorous chafing of the hands and feet hastens the return of the blood current. Vigorous skin friction by means of a rough glove or flesh-brush following a matutinal cold affusion or plunge is one of the most important means we have, not only to keep the skin active in its respiratory and secretory functions, but to tone up the muscles, vessels, and centres. An active muscular life under hygienic conditions will perform this service automatically, but brain-workers and sedentary people should take special measures to invigorate the skin and the vascular and organic muscular fibres of the body. In cases where there is a tendency to visceral congestion, and especially when the kidneys are overworked or disabled, skin friction should be systematically practised. Vigorous rubbing is an essential part of the Brand treatment of *typhoid fever* by cold bathing. Two attendants should constantly rub the patient's limbs, hips, shoulders, sides, and chest from the time he is immersed until he is removed from the bath, both to assist the refreshing effect of the bath upon the nerve-centres and to dilate the cutaneous capillaries, thus cooling the blood and reducing visceral congestion. So important is this friction to the therapeutic effect of the bath and in facilitating a normal reaction that the cold bath without it is likely to prove absolutely detrimental. These facts illustrate that rubbing, massage, and bathing are important forms of vascular gymnastics. Very gentle stroking is akin to tickling and is often exciting. Moderate rubbing or stroking has a decidedly soothing effect on the higher centres, and stroking of the forehead will sometimes relieve headache and produce drowsiness; if the rubbing is vigorously applied, the effect on the centres may be exciting and, if carried still further, depressing. If such decided physiological and therapeutical effects can be produced from ordinary friction, it is not surprising that the more developed manipulations of massage should possess considerable therapeutic importance.

As massage is, or should be, a scientific procedure, the manipulator, to be successful, must be versed in the principles upon which it is based, and trained in the art of practically applying them. Some anatomical knowledge is essential, but no amount of theoretical acquirement will compensate for lack of facility in the various manipulations and of certain personal characteristics. There is as much difference between a qualified masseur and an untrained rubber as there is between a trained nurse and a "Sairey Gamp," and, as with trained nurses, even the qualified manipulators vary from almost worthless to invaluable, according to personal characteristics and adaptability to particular cases. The successful masseur must be tidy in person, vigorous in health, and possessed of much muscular and mental tact. He must be content to act under the physician's orders and to abstain from suggestions in regard to treatment or other matters. Some masseurs of reputation appear to be possessed by the idea that great vigour of execution increases the efficacy of the manipulation, and defeat the objects of treatment by using violent rubbings and pinchings, even to the production of excoriations and contusions. Such roughness is entirely misplaced and wholly unjustifiable. Another point upon which misapprehension seems to exist in the minds of many is the proper duration of the *séance*. Its length will of course vary according as the massage is given for general or local effects, and for other reasons, but the ordinary session is certainly too long, and there is not the slightest scientific foundation for the absurd popular notion that it should normally last an hour. In most instances, if the massage is properly performed, ten to twenty minutes will be ample, as is, according to report, the practice of Mezger, the father of modern massage; too long sessions may defeat the object of the treatment.

Unless there exist special reasons to the contrary, massage should be given dry—that is, without the use of fats or ointments. It should usually be given under a blanket or wrapper, but sometimes the intervention of a thin, loose garment between the hand and the skin of the patient is not objectionable. When given for certain local purposes, as in the treatment of a sprain or bruise, the part to be manipulated must be exposed to view.

The question of the posture of the patient during massage has not been sufficiently studied. The patient should ordinarily be recumbent—though in massage of the neck he is seated—and it is obviously an advantage to

have the extremities slightly flexed, to relax the muscles and prevent constriction of the venous trunks at the flexures of the joints; and also to have the extremities elevated during manipulation, in order that gravity may aid the return of the venous and lymph currents toward the heart. Both the muscles and the mind of the patient should be in a passive condition. For this reason the personality of the manipulator should not be aggressive or unduly stimulating; men should be "masséed" only by men, and women by women. That the erotic sense may be, and often is, excited by manipulations given by one of the opposite sex, has been too little considered by physicians. They should also not be ignorant of the fact, verified both in this country and abroad, that practices of the most vicious description have flourished under the cover of massage and therapeutic manipulation. A prominent practitioner of New York took considerable pains, some years ago, to investigate the practices of a number of manipulators who advertised in the daily papers, and learned, from the admissions of these people themselves, that their establishments were regularly patronized for vicious purposes by the dissolute. After considerable evidence on this line had been collected, all the advertisements of massage establishments in a prominent daily, which had previously averaged fifteen or twenty such in each issue, suddenly ceased, and for a long time not one was printed in that journal. More recently revelations of a similar state of affairs in London have been published in the *British Medical Journal*. No practitioner can afford to recommend an operator whose character he can not personally vouch for. Murrell remarked seven or eight years ago: "It is a safe rule to have nothing to do with people who advertise," though doubtless many who do so are perfectly respectable.

There has been a great deal of mystery, not to say charlatanry, both in the prescription and in the application of massage. It has perhaps been as often prescribed as a placebo for fussy invalids as with any serious therapeutic intention, and while the ignorant rubber thinks there is some mysterious efficacy in his touch that will cure anything, the sphere of its really useful and legitimate application is rather limited. It may be made efficacious and important in its sphere. The technics have been needlessly cumbered in certain quarters with fanciful refinements and useless complications which scientific experience has already modified and will doubtless tend to still further simplify.

The more important manipulations, as used by Mezger, von Mosengeil, and others, are effleurage, pétrissage, massage à friction, and tapotement. It will be an aid in understanding the technics of the various movements if it is realized at the start that their object is mainly twofold—to stimulate the tissue elements within their sphere of action, especially the nervous, muscular, and glandular elements, and through them the centres with which they are connected, and secondly to soften the tissues and propel their more fluid parts along the veins and lymphatics toward the heart, or in the case of the hollow viscera toward their outlets. By these means the skeletal, vascular, and visceral muscular fibres are locally and in a reflex manner incited to action, the action of the mind and higher centres is aroused or soothed, and local congestions and effusions are removed with the soluble waste, improving the circulation and promoting oxygenation and a livelier metabolism. In order to fulfil the pumping function of massage, the manipulations should work in the soft parts toward the heart, following the direction of the venous and lymphatic trunks. It is not necessary in order to accomplish this to begin the manipulation at the extreme periphery; many operators prefer to first empty the vessels and tissues nearest the centre, and to work back toward the periphery, but in this case also each single manipulation is performed centripetally. This plan is preferable when there is congestion or swelling of a limb or joint. If the knee, for example, is affected, the thigh is first centripetally manipulated, then the affected part and the leg. In fulfilling the first indication, that of stimulating the part and its connected centres, one has to carefully consider the rapidity and force of the movement employed. Very light stroking, just grazing the skin, may powerfully stimulate the centres. Manipulations moderate in force and frequency and with a regular rhythm are soothing; energetic and rapid movements are stimulating, exciting, or depressing, according to their duration and to the reactive powers of the tissues.

Effleurage is a stroking movement, usually centripetal, made with the palm of the hand or the volar surfaces of the fingers, and should be made along the muscles and in the direction of the veins and lymphatics, the two hands being used alternately. Stroking is not of very great efficacy in itself, and is mostly used to arouse the centres and stimulate the superficial vessels as a preparation for or a finish to the more vigorous movements; it is made more or less rapid and forcible, according to the effect desired. The effects of moderate effleurage are mainly to increase the pliability and improve the circulation and nutrition of the skin, to warm the surface by drawing blood from the deeper parts, and to act on the nerve-centres through stimulation of the myriad sensory papillæ near the surface of the body. Strong effleurage is of service in forcing fluids toward the heart.

Pétrissage is "a mobile intermittent compression," a kind of kneading affecting the deep-seated tissues, and is perhaps the most important movement of the series. A handful of muscle or other soft tissue is grasped firmly, but without violence, and evenly pressed or squeezed between the cushions of the thumb and fingers; the handful is rolled while the hands are moved somewhat transversely in opposite directions. It is well to work with the balls of the thumbs and volar surfaces of the fingers, rather than with the tips, and stiffness of wrist and fingers should be avoided. The movements are centripetal, and should systematically cover all

the soft parts of the manipulated area; the muscles should of course be relaxed, and the skin should move with the hands. If the operator will bear in mind at the same time the sensibility of the patient and the analogy between this procedure and the effort to empty of its contents a sausage open at one end by rolling and pressing it in the grasp of the hands, the manipulation will be more likely to be effective, and practice will give evenness and grace to the movement. Pétrissage stimulates the tissues of the deeper soft parts, makes them more flexible, softens indurations, removes exudations and waste, and brings in fresh blood, relieving the congestion of neighbouring parts. The muscles are especially affected, and their nutrition and functional activity improved.

Massage à frictions is a movement designed to soften and rarefy congested and indurated tissues. It is employed chiefly in affections of the joints, both for treatment and for diagnosis, and also for other local indurations. "The finger tips of one hand held at right angles to the axis of the limb rub across and across in narrow ellipses, while the fingers of the other hand stroke parallel to the axis of the limb" (Beuster, according to Lee). The movement should begin at the periphery of the indurated area and the pressure should be toward sound tissue; it should always conclude with centripetal stroking. This manipulation must not be confounded with ordinary friction or rubbing.

Tapotement, percussion, or beating, may be performed "with the tips of the fingers, their palmar aspects, the palms of the hands, the back of the half-closed hand, the ulnar or radial borders of the hand, or with the hand flexed (cupped) so as to contain, when brought into contact with the body, a cushion of air." The strokes should follow each other rapidly and evenly, and the movement should last only a short time. Percussion is given with stroking and kneading, and also separately for special purposes. This manipulation stimulates muscular and nervous activity, and its effects are transmitted from the surface to the centres and to underlying organs. "Percussion is to massage what faradization is to electricity" (Graham). Strong and rapid percussions have an analgetic effect, and are used in *neuralgias.* In certain spasmodic affections the percussions are thought to initiate a new and more orderly rhythm of nervous discharge, which tends to modify or replace the irregular rhythm of the diseased state.

The foregoing manipulations comprise massage as practised by Mezger, von Mosengeil, and others; besides these movements, shakings and vibrations are largely employed, especially for the relief of pain, but are more efficiently administered by means of special apparatus. Passive, assistive, and resistive movements—the so-called Swedish movements—are often added to the manipulations, and in many cases form the most valuable feature of the treatment. It is necessary for masseurs to understand and practise Swedish movements, but they are not included under the term massage in this article.

Special manipulations are required for special regions, of which two—massage of the neck and massage of the abdomen—require separate mention here. Dr. Gerst found that massage favoured absorption of exudation in the extremities, even when applied at a distance; he therefore applied *massage to the neck* in congestion of the head and in catarrhal affections of the upper air-passages. He found that the area drained by the jugular vein became depleted after neck massage, and that congestion of the face and the sensation of fulness in the head were relieved. Gerst's method is as follows: The patient stands facing the operator, with the neck and shoulders bare, the head inclined backward and the relaxed shoulders hanging forward; he is told to breathe quietly and regularly. The neck is then stroked for ten minutes in the following manner: The open hands with the palms up are placed with their ulnar edges in the right and left crease between the head and neck in such a way that the ends of the small and ring fingers lie behind the ear upon the mastoid process, and the ball of the little finger below the body of the jaw. With the hands in this position the centripetal strokings of the upper part of the neck are begun. While their ulnar edges are moving toward the median line of the neck, the hands are turned upon their own axes so that their radial edges become uppermost, and finally occupy the position first taken by the ulnar borders of the hands. The entire palmar surface is thus applied to the neck and is then used for stroking downward. When the supraclavicular fossa is reached, the hands are turned until the stroking is done by their radial edges. Weiss's method is specially applicable to adults with thin necks and to children. The operator, seated in front of the patient, interlocks his fingers behind the patient's neck, the thumbs resting below the ears. From this position the thumbs stroke downward from the jaws to the clavicles, they are then lifted and returned to the starting point, and the stroking is repeated. In Hoeffinger's method, which is the easiest, the operator stands behind the seated patient and places the fingers on each side under the lower jaw, the thumbs resting behind the neck. The antero-lateral portions of the neck are then stroked downward and outward with the fingers.

For *abdominal massage* the patient lies with the shoulders and chest elevated and the knees drawn up to relax the abdominal muscles, and breathes quietly and regularly. Reibmayr, according to Dr. Benjamin Lee, makes use of four distinct manipulations, using the first or second to stimulate peristaltic movements, and adding the third or fourth to the second if it is desired to act mechanically upon the intestinal contents. The first manipulation consists in tracing enlarging circles with varying pressure around the umbilicus with the tips of the three long fingers of the right hand, the end of the thumb lying sideways upon the abdomen and serving as a fulcrum for the motion. This manipulation is often irritating to nervous people, and may be replaced by the second, which consists in describing circles around the navel with the palm of

the hand. The hand is extended to a right angle with the arm, and pressure is made principally with the balls of the thumb and little finger; the finger tips follow passively. The manœuvre is well borne and rarely causes pain. In both these movements the motion is from the patient's right side to his left above the navel—that is, in the direction of the hand of a watch. The third manipulation is performed by the right hand laid flat upon the right inguinal region, the finger tips pointing downward. The left hand makes pressure upon the first phalanges of the right and the stroking is performed with the hands in this position, from below and within, upward and outward, following the course of the ascending colon. In returning, the hands pass downward over the navel, making scarcely any pressure. The fourth manipulation is similar to the preceding, but is applied upon the left side of the abdomen, the tips of the fingers being directed upward. This movement is from above and without downward and inward. During this manipulation the patient should have the upper part of the body raised at an angle of 45 degrees.

General massage of the body consists in firm centripetal stroking and kneading of the surface, especially of the limbs and back; the *séance* may be ended with tappings or followed by abdominal massage or Swedish movements when indicated.

Besides manual massage, *mechanical massage* by means of power apparatus has been employed by some, but no machine equals in delicacy and efficiency of manipulation the tactful trained hand. Percussors and beaters, usually of rubber, may be used for tapotement, and vibration machines may sometimes be employed with advantage. Massage and electricity have been used conjointly as *electro-massage*, but the method has no scientific standing; the two agents should usually be applied separately. Very recently *hydraulic massage* has been tried with asserted success in improving the circulation and flexibility of rheumatic and paralytic limbs. The method consists in creating violent currents by means of a powerful pump in a cylinder of water, in which the limb is immersed. The ordinary jets, sprays, and douches of hydrotherapy also perform a kind of massage. *Douche massage* as practised at Aix-les-Bains is performed by two operators who direct upon the patient a strong douche from a nozzle held under the arm at the same time that they administer massage.

Physiology.—There is considerable confusion and not a little discrepancy in the accounts of the physiological effects of massage as given by different authorities; much of this arises from variations in the conditions of the observations, which are often not fully stated. It must not be forgotten that the physiological effect varies with the kind of manipulation, its direction, rapidity, duration, evenness, and force—in other words, with the technics and the dose; and also with the condition of the part operated upon and the general condition of the patient. It will help to simplify the consideration of its different effects to bear in mind that massage is a "mobile intermittent compression" acting upon the organism mainly in two ways: first, as a stimulus to such structures within its sphere of influence as are capable of physiological reaction, particularly nervous, muscular, and glandular elements; and secondly, as a mechanism for softening tissue and exudates and for pumping the fluids of the parts in the direction of least resistance, usually toward the heart. The two effects are not only simultaneously brought about, but react reciprocally upon each other, since the stimulation of muscular fibres assists the pumping action, while the pumping draws fresh blood into the part, increasing functional activity.

The direct stimulation of cellular elements by massage is well illustrated in its effect upon the mammary gland during lactation. It is now recognised that gentle massage of the breast is the best *galactagogue*, while to lessen the secretion of milk, firm and even compression is employed, and all manipulation, even that intended to empty the breast, is carefully avoided. The stimulation of muscular fibres by manipulation is utilized in Credé's method of assisting the expulsion of the placenta.

In percussion and mild stroking the preponderating effect is stimulating, as the nerves and their endings are mainly affected; in *massage à frictions* and kneading the communicating and pumping action predominates. The word "stimulating" is generic, and is used to denote an incitement to functional activity, but the resultant effect varies greatly according to the grade of the stimulus and the functional activity and reactive capacity of the responsive structures. The stimulation resulting from massage may be soothing, tonic, exciting, irritating, depressing, or exhausting, according to extrinsic and intrinsic conditions, and may be varied to produce these different and even opposite effects. Gentle stroking and percussion cause direct and reflex stimulation of the cutaneous and subcutaneous vessels with contraction of their arterioles and acceleration of the capillary current; while vigorous movements cause their dilatation, redness of the skin, and elevation of the surface temperature. Stagnation of the blood-current is, however, prevented by the pumping action of the movement, which even in stroking, if the movement is centripetal and vigorous, is considerable. Kneading produces similar effects upon deep-seated structures as well, producing contraction of the voluntary and involuntary muscular fibres, both directly and in a reflex way, and affecting the nerve-centres and underlying organs, through the nerve endings and fibres of the manipulated part. The alternate contractions and relaxations of the manipulating hand also soften the tissues, stretch or break adhesions, comminute or liquefy solid or semi-solid exudations and deposits, and act, moreover, as a sort of rude heart, squeezing the tissues like a sponge, expressing their areolar juices, impelling fluids, soluble waste, and suspended particles into and along the venous and lymphatic channels, and aspirating arterial blood toward the manipulated part.

The contraction of the skeletal muscles is normally a most important agent in assisting venous and lymph return, acting as a kind of internal massage, which fills and empties the vessels by alternate contraction and relaxation. Where muscular activity is deficient, massage steps in to supply this aid to the return circulation, and to assist the absorption of effusions beyond the reach of muscular action. Von Mosengeil has shown that a thick solution of India ink injected into the joints of rabbits was dispersed and the subsequent swelling allayed by massage of the parts; when these joints were afterward opened, no ink was found in them, though it was found abundantly in the areolar tissue, muscles, lymphatic vessels, and glands above the manipulated joints. Such joints as were not treated remained swollen for a considerable time, and when opened were found filled with India ink mixed with synovial fluid. In this case the surrounding tissues and lymphatics were free from ink.

The stimulating and pumping effects of massage go hand in hand, and result in improved circulation, nervous action, and nutrition, and in increased metabolism and functional activity. Thus massage makes the skin soft and pliable, and, by increasing its circulation and nutrition, and those of the subcutaneous tissues, tends to improve the complexion and efface wrinkles. "Facial massage," which has had a certain vogue, is an attempt to turn these effects to account for cosmetic purposes.

Massage both removes waste and brings nutriment to the "masséed" tissues, or, as Graham graphically puts it, "it adds fresh fuel to the fire, while removing the ashes, at one and the same time increasing the functions of the circulation as marketman and scavenger." This goes far to explain the important effects of massage in conditions of acute fatigue, whether muscular or central, as well as in those chronic forms of fatigue known as overwork and neurasthenia, in which imperfectly oxidized decomposition products habitually intoxicate the system. Professor Maggiora, of Turin, has performed a series of exact experiments to show the effect of massage on fatigued muscles. As stated by Graham, he endeavoured to ascertain—

1. The action of massage in a state of repose. For this purpose the fatigue curves of the right and left middle fingers in maximum voluntary flexion every two seconds with a weight of three kilogrammes were taken at given intervals without massage. The following day the fatigue curves of the same muscles were taken after three minutes of massage, but otherwise under the same conditions. The average result showed that the muscles did almost twice as much voluntary work after three minutes' massage as they did without. The same results were obtained when the contractions were due to the electric current.

2. The second series of experiments was undertaken to ascertain whether the benefit of mixed massage (stroking, percussion, and kneading) increased in proportion to the duration of the application. At 8 A. M. the normal fatigue curve was taken, and again every two hours and a quarter after this, being preceded by two, five, ten, and fifteen minutes' massage of the muscles of the middle finger. The tracings showed that almost all the useful effect that could be produced was obtained after five minutes of massage. With electrical stimulation similar results were obtained.

3. The third series of experiments was to determine the relative value of stroking, percussion, and kneading under similar conditions. It was found that with five minutes of manipulation stroking stood lowest in restorative effect; then came percussion; but that the greatest increase of work followed *pétrissage*. The best effects, however, were obtained after an alternation of the three. The same order of efficiency held true when the muscles were electrically stimulated.

4. The effect of massage upon muscles weakened by fasting was such as to temporarily restore them to a normal condition of efficiency; and this was also the case when the muscles were stimulated electrically.

5. The action of massage upon muscles tired as a result of general fatigue was also studied. After a walk of ten miles, Professor Maggiora took a fatigue tracing of both middle fingers, and found they were capable of only one fourth of their normal work. After ten minutes' massage to the hands and arms they did a normal amount of work. This result was more than equal to two hours of repose, for it was found that that length of time was required to produce a normal fatigue curve, when the finger muscles alone had been tired.

6. After loss of sleep muscular efficiency was found to be very low, but ten minutes of massage increased the curve to beyond normal, and this result could not be obtained by nourishment or tonics. In the fatigue of muscles from fasting rest alone brought no appreciable relief, and in fatigue from wakefulness nourishment did not restore the muscles to their former vigour.

7. After the final examination of twenty medical students, lasting five hours, Professor Maggiora was much exhausted and took fatigue curves of both middle fingers. They were about one fifth of the normal. Half an hour later, after ten minutes of massage, they were nearly normal.

8. After a slight febrile attack the muscles were weak the next day. Massage restored temporarily a nearly natural curve of the flexors of the middle fingers.

9. It was found that anæmia of the muscles for from three to five minutes produced phenomena similar to those of fatigue, diminishing their vigour and capacity for work. With a weight of one kilogramme attached to his middle finger, Professor Maggiora produced 265 contractions without fatigue, but when the brachial artery was compressed, the finger could contract only eleven times. While the arterial current was still shut off massage was performed for three minutes, but the muscles could only contract nine times. Massage has therefore no effect on fatigue when the arterial blood supply is cut off.

The secondary and indirect effects of massage in aspirating blood from the surrounding tissues to the manipulated part are both far-reaching and important. The amount of stagnant blood is reduced and the circulation quickened in neighbouring parts, and upon this fact depends the observed beneficial influence on the healing of *burns*, *ulcers*, and even *fractured bones*, when massage is performed in their vicinity. In the same proportion that blood is drawn toward the manipulated part, it must be withdrawn from underlying or surrounding parts; if there is internal congestion, massage of the skin and muscles tends to relieve it and to equalize the circulation. When an injured or inflamed part is too tender to manipulate, relief may often be obtained by massage of the surrounding area, and especially of the region between it and the heart. Massage used in this way to press the fluids away from the congested area, and especially toward the heart, is as "antiphlogistic in its effects as warm fomentations to the seat of disease. A diminution of the tension, the swelling, and the pain may always be accomplished by introductory massage alone" (Reibmayr, quoted by Lee). Massage is often used in this way in injuries about joints, to reduce swelling and tenderness in order to permit a more searching examination.

Many of the effects already described are produced or intensified by the modifications of nerve-centre action induced by the stimulation of nervous elements in the manipulated area. The vascular fibres of unstriped muscle not only respond directly to the varying pressure, but are even more affected by stimuli reflected from the centres, causing alterations in their tonicity. The muscular fibres of deep-seated organs like the stomach and intestines not only respond directly to manipulations, but are even more profoundly affected by the consequent reflex stimulation. If muscular or vascular tone varies but little in two given areas, massage of one will distinguish its tonicity. If, on the other hand, two given areas differ in tone, massage short of overstimulation, applied to the area of greater tonicity, will increase the difference; applied to the area of lesser tonicity, it will tend to equalize the two. In other words, massage may be used to increase or diminish local differences in circulation or muscular tonicity, according to the site and technics of the manipulation.

After muscle kneading Eccles found that the surface and axillary temperatures were always increased if the patient was kept covered, while the rectal temperature was diminished. The frequency of heart-beats was sometimes increased, but more often diminished; the blood-pressure was always increased, as shown by the sphygmograph and manometer. After abdominal kneading the surface and axillary temperatures were diminished and the rectal temperature was increased. The cardiac rhythm was always slower and the blood-pressure less after abdominal massage, showing the necessity of special discretion in its employment.

Massage of the abdomen, by its stimulating and mechanical effects, overcomes *intestinal inertia* and facilitates the discharge of the contents of the bowels. Massage over the stomach from left to right, with a slow rhythm and at intervals, in imitation of the natural movements of the stomach, hastens the discharge of food from the stomach into the duodenum. Chpolianski found that two eggs remained four hours and fifteen minutes in the stomach without massage, but when massage was administered for ten minutes the stomach was empty after two hours and forty-seven minutes, as ascertained by the stomach-pump. Experiments by Hirschberg with salol show that when it is swallowed, salicylic acid appears in the urine sooner and disappears from it sooner with massage, and also with walking, gymnastics, and faradization of the gastric region, than without these agents. As salol is not decomposed into phenic and salicylic acid until it has left the stomach and is acted upon by the alkaline juices of the intestine, these experiments show a more rapid emptying of the stomach when local massage is given. Various experimenters have shown that the wonderful absorptive powers of the peritonæum are increased by massage of the abdomen. According to Reibmayr (Lee), when rabbits into whose peritoneal cavities about 200 centigrammes of warm water had been injected were subjected to ten minutes of abdominal massage, two or three times an hour, the absorption in the first hour was about doubled, but in two hours it was only a third more than without massage. According to Hirschberg and others, abdominal massage has a marked *diuretic* effect, probably due to changes, direct and reflex in blood-pressure, in the abdominal and renal vessels. Reflex effects other than vascular phenomena are produced especially by stroking and percussion. Percussion over the lower part of the chest increases the depth of the respirations; percussion over the abdomen slows the heart and reduces arterial tension. Stroking over the abdomen increases peristalsis. Stroking over the inner aspect of the thighs causes contraction of the cremaster muscle, and massage in this vicinity often excites erotic sensations and erections. This is a matter too much ignored and renders imperative, under ordinary circumstances, the employment of an operator of the same sex as the patient, and of caution in the use of manipulations in erotic individuals.

Massage exerts an important effect on the central and axial ganglia, not only by modifying their circulation in a reflex manner and through depletion, but also directly by means of the afferent impulses sent along the nerves which end in the manipulated part. Every change of temperature, pressure, tension, position, and reaction is telegraphed to and registered in the higher centres, and may profoundly modify cerebral processes and states of consciousness, though the results of circulatory changes are more evident. Downward stroking over the jugulars, and manipulations of the larger muscular masses, by draining the blood from the head, allay cerebral excitement and favour sleep; moderation and regularity in the

force and rhythm of the manipulation increase its efficiency, and the depletory effect may be neutralized or overbalanced by the irritation of rough or irregular movements. If the functional activity of two given centres is equal, the stimulation of a peripheral area connected with one will differentiate its tonicity. If the one area is more sluggish, or the other more excited, this difference would be increased by massage, short of overstimulation, applied to a peripheral area connected with the more active centre, but diminished if massage is applied to a peripheral area connected with the more passive centre.

The general effects of massage follow from the special effects described; oxidation and metabolism are increased, the circulation and nutrition improved in the system at large as well as locally. A richer and purer blood assists more vigorous tissues to perform their functions more naturally and easily. The circulation and nervous action, more advantageously and harmoniously distributed, increase the bodily powers and the sense of vigour and well-being, and banish fatigue. Zabludowski studied the effect of daily massage for ten days on three healthy persons, and found in all an increase of muscular strength; decrease of corpulence in one, and in one increase of weight; increase of excreted urates and phosphates when the weight was reduced; decrease of excreted urates and increase of sulphates when the weight was increased. In all there was improved appetite and sleep and increase of vital tone.

Gopadze's experiments were performed on four medical students, who received daily massage for a week. He found the appetite increased both at the time and during the following week or two. Nitrogenous transformation was increased. During the week of massage two gained and two lost in weight, but all gained in the week following. The respirations were increased in depth and frequency.

Massage produces some of the effects of exercise of the skeletal muscles, notably stimulation of the vascular and other unstriped fibres, and aids in the venous, lymphatic, and arterial circulation of the part. Exercise of the skeletal muscles produces a real massage of the surrounding parts; massage, however, is far from being a complete substitute for exercise of the skeletal muscles, being deficient in the powerful effects of the latter on the heart and respiration, and differing in its effects on the central nervous system. The fresh air and change of scene furnished by exercise out of doors are also lacking.

Therapeutics.—There is little doubt that the employment of massage as a practical remedy in those disorders where it is really efficient has been unduly restricted with many intelligent practitioners, on account both of extravagant statements as to its efficacy and of the paucity of specific directions for its employment. It has been recommended with more or less assurance in nearly every known form of disease, and while it has in recent years occupied a place in medical literature out of all proportion to its real importance, this literature still leaves much to be desired in the way of systematic exposition of its physiological effects and specific and reliable indications for its employment. Its efficiency, as compared with that of other remedies, and its relation to their employment, should be more distinctly stated. Massage is not a specific in any form of disease, but it is a reliable means of producing certain definite physiological effects under given conditions, and may be made a therapeutic aid of importance where such effects are indicated. These effects are in part purely mechanical, in part stimulating to responsive tissues, and this stimulation may produce ultimate sedative, exciting, or depressing effects according to the technics, dose, and prevailing intrinsic and extrinsic conditions. "According to the requirements of individual cases, massage may be of primary importance, or of secondary importance, of no use at all, or even injurious. In what affections and in what stages is massage beneficial? Briefly answered, . . . in local and general disturbances of circulation, locomotion, and nutrition in their incipient stages, or after the acute symptoms have passed away. At the commencement of many affections local congestion and irritation will often be relieved by massage, and this may serve for cure or prevention of further mischief. In cases that have come to a standstill or lapsed into a chronic condition, languid circulation will be aroused, waste products absorbed, and nerves and muscles nourished and strengthened" (Graham).

Dr. Mezger, to whom more than to any other one man is probably due the modern revival of massage, and who has had an enormous personal success in its administration, is very careful in the selection of cases. Some patients, personally known to the writer, who would have been accepted here by qualified operators, were unhesitatingly rejected as not suited for the treatment when they applied to Mezger. I have particularly in mind a bad case of lateral curvature and a case of impaired nutrition from functional disturbance of the alimentary tract.

It should not be forgotten, moreover, that massage, like other remedies capable of producing positive and important physiological effects, is also capable of doing harm when applied without regard to the indications for its employment, the condition of the patient, and to proper technics and dose. It should not be administered in a soothing manner when the patient needs to be aroused, or in an irritating manner when the patient requires to be calmed. When too energetically or too long administered, it may prove exhausting and detrimental to a very delicate patient or to one in a critical condition. Especially when the nerve-centres are impaired by disease, as in the hemiplegias following apoplexy or embolism, are they easily overworked and strained. Graham reports having unduly fatigued two old hemiplegics by thirty to forty minutes of massage daily for a few days only. The danger of exciting the erotic sense in susceptible persons has already been mentioned.

The danger of diffusing the micro-organisms of suppuration and tuberculosis contra-indicates the employment of massage in the vicinity of these processes. Cancer and thrombosis also contra-indicate its use. One should not be deceived by the absurd dictum, so often heard with reference to homœopathy, that it at least can do no harm. In the case of massage this is certainly not true, and this is a strong point in its favour, since otherwise it would be incapable of producing important physiological effects. Like all rational remedies, it must be employed with skill, judgment, and discrimination to be beneficial or even safe.

Before proceeding to consider the applicability of massage to pathological conditions, reference should be made to the employment of massage in health. A good rubbing, kneading, or shampooing after athletic or other severe exercise is an excellent refresher, invigorator, and preventer of subsequent lameness and stiffness; this result is effected by the readjustment of the circulation, the elimination of waste, and the gentle stimulation of the tissues and centres. Systematic skin friction, especially in connection with fresh air, exercise, and cold bathing, is an important aid to health, beauty, and vigour, and a powerful prophylactic against disease. Such rubbings, however, in the case of men and women who take too little exercise, are best self-administered, since there accrues the double benefit of the special effect of the rubbing and the general effect of the exercise necessary to administer it. If it were understood that grooming was just as potent an invigorator and beautifier for a human being as for a horse, there would be more vigorous men and beautiful women. Grooming in some shape—that is, the toilette of the skin and the culture of the neuromuscular apparatus of the so-called vegetative system—should form a regular feature not only of child life but of adult life. This is all-important for those who lead a sedentary life, deficient in those stimuli which bring vigour to the skin, vessels, and centres, and to those neuro-muscular mechanisms upon whose automatic and ready adjustability to changing environment our physical safety depends. Varied and vigorous exercise of the skeletal muscles, cold bathing, and life out of doors should be added to the grooming in order to produce the maximum effect in beautifying, rejuvenation, and invigoration. Massage is not an efficient substitute for exercise of the skeletal muscles, but leads up to it, supplements it, and mitigates its severe effects. The custom in vogue in certain circles of the lazy and luxurious of taking massage avowedly as a substitute for exercise, but really on account of the pleasurable sensations, often erotic or semi-erotic, evoked, is not free from serious dangers and abuses. If no worse effect is produced, the individual is more apt to be confirmed in his indolent habits than weaned from them, and the craving for and indulgence in this form of stimulus may become a habit comparable to a drug habit.

It should be noted that in Sweden, where local massage is so largely employed for therapeutical purposes, general massage is almost unknown.

General massage, even for invalids, usually finds its most useful employment when used as a step in a system leading not only to functional restoration, but to active voluntary exercise. It breaks the transition from disability and invalidism to muscular and organic competency. Passive and duplicated exercises, bathing, and exposure to fresh air are equally important steps in the process. Poorly nourished persons of low or slow vitality may have their organic processes raised or quickened by judicious massage, and the increased functional activity will tend to promote the development of the muscular and other tissues. In *anæmia* massage has been found particularly useful, especially in connection with the cold wet pack and other hydriatic procedures. Persons affected with *corpulence* may have their surplus of imperfectly oxidized material reduced through the increased metabolism provoked by massage, and so lose flesh; active exercise is, however, a more powerful consumer of the bodily fuel.

It is especially in *nervous disorders* that the greatest successes of massage have been scored, and particularly in the large class of bed-fast or partially bed-fast subjects of *neurasthenia*. Dr. S. Weir Mitchell has given an enormous impetus not only toward the successful treatment of these unfortunates, but also to the systematic treatment of chronic diseases in general, by his demonstration of the value of seclusion, recumbency, and systematic feeding, with exercises, massage, electricity, and personal control. Massage is a valuable but not indispensable element in this co-ordinated plan. In many cases it can readily be omitted if the physician is familiar with the application of passive and duplicated movements, or if the patient is sufficiently impressed with the physician's personality to be willing to face about in the matter of previous daily habits and routine. It should not be forgotten that prolonged recumbency is after all abnormal, and that it is frequently contra-indicated. Change of environment, with or without seclusion, and a coherent and progressive neuromuscular and mental training by some effective agency, are in the beginning the requisite features of treatment in most of these cases. This multiform disorder well illustrates how the mode of application of massage must be varied to fulfil such indications as may appear in the progress of each individual case. It may be used to allay nervous irritation and to promote sleep by means of soothing applications at bedtime, or by more vigorous manipulations to arouse and stimulate the system and prepare it for the more active forms of exercise. On the other hand, it may be used to counteract the effect of fatigue and stiffness following muscular exercise. It may also be used for its general or local effect on the circulation and for its local effect on muscular spasm or on neuralgic pains. Neck massage may be require for headache or sleeplessness, massage of the back with percussion for backache, and abdominal massage for constipation. These

are some of the ways in which massage may require to be varied to meet special indications in a case of this class; the effects usually desired in such cases are principally those on the nervous system, on the circulation, and on nutrition; many beneficial general and local effects follow from these as a secondary consequence. In typical *neurasthenia* it is probable that decomposition products are present in the blood and tissues in abnormally large proportion, and massage, by its stimulating effect on the circulation, nutrition, and elimination, counteracts this condition and gives tone to the relaxed centres, vessels, and tissues.

For *insomnia*, gentle stroking and kneading may be administered in the evening. The moderate rhythmical stimulation has a soothing effect upon the centres, which is enhanced by its restful effect upon fatigued tissues. Administered at any time during the day, massage will tend to improve sleep by increasing the general vigour and tone of the system.

Good effects have been reported from the use of recumbency, a nourishing diet, and massage for a quarter of an hour twice daily in *chorea*. The massage was given in a systematic manner, the various muscle groups being manipulated in a definite sequence, so that order in the discharge of nervous impulse might be re-established. This plan of treatment was followed by improved circulation and nutrition, increased weight, slowing of the heart's action, and rapid subsidence of the more violent abnormal movements.

A course of massage from time to time is said to do good in certain cases of *locomotor ataxia*, both by its general effect on nutrition and circulation, and possibly also by its local effect in freeing the nerves and tissues from indurations and adhesions. Disturbances in sensibility may improve after such treatment; and percussion over the affected area has been successfully used for the neuralgic pains. Such measures are of less value than Bernuzzi's method of stretching the spinal cord and sciatics by flexing the thighs on the pelvis until the feet take a position each side of the head, which may be regarded as an indirect way of "masséeing" the cord itself.

Massage has been highly recommended in the *palsy* and *vaso-motor paresis following acute poliomyelitis*. To facilitate locomotion by suitable mechanical means is, however, much more important for both conditions, and the local application of dry heat is of great value in improving the circulation of cold extremities.

Neuralgias, especially those due to peripheral disorders, such as neuritis, exudations, and adhesions, may often be relieved by the softening and detergent effects of massage, while percussions and vibrations are said to be peculiarly efficacious in this class of affections, due probably to the depressing effect on nerve-centre function of over-stimulation, and of trauma or conduction. As massage may be so applied as to profoundly affect centres remote from the point of application, neuralgias of central origin are sometimes relieved by massage and percussion. *Sciaticas* have been reported cured by massage, but enforced recumbency with the limb in a splint or sling is probably more efficacious. As the causation differs in different cases, no one remedy will always succeed.

Severe *headache* and *hemicrania* often yield to neck massage when the trouble is due to congestion, while stroking of the forehead and temples, or shampooing of the head, may bring relief in anæmic headaches. Norström has found that many cases of hemicrania are neuralgias due to nodular centres of induration of inflammatory origin along the muscles of the nucha. These points are tender and may be found by palpation when the trapezius is relaxed. These nodules may be removed and a cure effected by the use of massage.

Massage has also been successfully employed in certain *painful spasmodic affections*, particularly in the *occupation neuroses*, such as *writer's*, *telegrapher's*, and *pianist's cramp*, when combined with judicious systematic muscular training, and with special exercises it has scored great successes, particularly in the hands of J. Wolff. Here, as in so many instances where massage has a pre-eminent reputation, the various developing exercises appear to play a predominant rôle. Massage is highly recommended in *lumbago* and other forms of *myositis* or *muscular rheumatism*. The manipulations are said to break up indurated and adherent tissues and restore normal circulation and function.

As to *rheumatoid arthritis*, some cases of benefit have been reported, partly due to the improvement in nutrition, which is always faulty in these cases, and partly to local effects on the stiffened joints.

Abdominal massage has been widely used for *intestinal torpor*, and with benefit in many cases. It should usually be used in conjunction with or as an introduction to active exercise and life out of doors. Its depressing effect upon the surface temperature, vascular tone, and heart action, if long continued, should be borne in mind. Its marked diuretic effect might be made use of in *suppression of urine* and to carry off *ascitic accumulations*. Hirschberg recommends massage of the stomach from left to right in *dilatation* of that organ, to stimulate it to contraction, and to mechanically hasten the progress of its contents into the duodenum. General massage is often prescribed in the various forms of *functional dyspepsia*, and it may well serve in some cases as an introduction to therapeutic exercises. Massage of the abdomen and hepatic region has been employed with asserted benefit in *gallstones* and *jaundice*.

The general effects of massage, and particularly of therapeutic exercises, have been found to be of great advantage in conditions associated with disorders of the female reproductive organs. Enlightened gynæcologists have known for some time that many so-called "uterine" cases can be most effectively reached by toning up the system by means of diet, bathing, massage, exercise, fresh air, and attention to the morale of the patient. In many such cases the uterine or ovarian disorder is either cured by the affected organ's sharing in the general improvement of circulation, nu-

trition, and nervous tone, or, if remaining in some degree, its symptoms are not sufficiently prominent to attract attention. In recent years Thure Brandt and others have employed local manipulations and special exercises for certain *intrapelvic disorders of women*, and have alleged special advantages for this mode of treatment. Dr. R. Ziegenspeck says that "Brandt's method is indispensable in the cure of *chronic parametritis* and the neuroses to which it gives rise." He predicts that it will greatly restrict or abolish castration for reflex neuroses, and will prove a formidable rival to ventrofixation, Alexander's operation, and other operative procedures for backward displacement of the uterus. Dr. E. Arendt says that "the results in the hands of physicians who have learned the process from its author were surprisingly good." Brandt has adopted from the Swedish system certain active, passive, and duplicated movements which, by attracting blood to the moving parts, modify the supply in the pelvic organs. The *séance* begins with a respiratory movement, which is followed by exercises of the hips, head, neck, lower extremities, and breast. There are variations to meet special indications in each case. Movements which lessen pelvic blood-supply are indicated in menorrhagia, metrorrhagia, and pelvic inflammation; movements producing a contrary effect are required in amenorrhœa.

Massage proper, which is contra-indicated when pus, tubercle, or cancer is present, is performed by making small circles over the abdomen with the right hand, while the left steadies from the vagina the organ to be acted upon and lifts it toward the manipulating hand. In *prolapse* and *malpositions of the uterus* and *prolapse of the rectum* various methods of manual reposition and lifting are employed. These and the massage should be painless if properly performed, and are to be followed by derivative exercises. Effusions, exudations, adhesions, and indurations are carefully and gradually rubbed out between the two hands. Ziegenspeck, of Munich, says that he has tried Brandt's plan for endometritis, but has returned to Schultze's method, antiseptic irrigation, and tamponing, as giving equally good results with less trouble. The tents and gauze tampons now in vogue provoke uterine contractions, so that the organ in a sense performs massage upon itself, and the indurated tissue is softened and freed from exudations and morbid secretions by the contractions of the uterine muscular fibres, which also improve local nutrition. Vaginal tamponing is of course a kind of lifting. Brandt treats *incontinence of urine* in women, resulting from relaxation of the sphincter vesicæ, by firm manipulations of the neck of the bladder and by pressing the urethra against the pubes, the finger being in the vagina or, in the case of children, in the rectum. The urethra and sphincter are stimulated to contraction by the pressure. Adduction of the thighs, "lifting of the bladder," and stretching the urethra with a sound may be used in addition. We have too much evidence in favour of the Brandt method to dismiss it lightly, but it is evident, from the nature of the manipulations, that the cases must be carefully selected, and it is probable that they would be less successful in the sensitive women of this country, where the ever-present danger of local treatment for diseases of women is the cultivation of a morbid interest in and attention to pelvic symptoms, which are often so seared into consciousness as to dominate sensation, thought, and action to a degree out of all proportion to the importance of the actual lesion.

In surgery the uses of massage are mainly local. It has been used on the healthy skin in the vicinity of *burns* and *ulcers* and also on the ulcer itself to stimulate the circulation, tissue change, and the elimination of effete material, and thus to promote healing. Massage in the vicinity of *fractures* is said to accelerate their union, and Graham asserts that *sprains* get well in one third of the time under massage that is required under the usual treatment. The injured joint or member is gradually approached from the sound parts about it, and not until these have been well "masséed" should the bruised or lacerated tissues be manipulated. In *bruises, lacerated muscles* or *ligaments*, and *traumatic synovitis*, the absorption of effusion is hastened and tenderness and disability are alleviated by the judicious use of *massage à frictions*, after preliminary centripetal stroking and kneading along the course of the vessels on the cardiac side of the injury. Those who employ massage in acute sprains and joint injuries usually advocate the use of passive movements with it, and rely little or not at all upon retentive apparatus. This plan seems at first sight to contradict the accepted idea that injured and inflamed tissues require rest. It must be remembered, however, that rest from motion is often less essential than rest from pressure, and that if massage can relieve a joint or other part from the injurious pressure and strain of effused material and swollen tissues, it is conceivable that motion, which would otherwise be highly injurious, because accompanied by friction and pressure, might be harmless within certain limits. To one familiar with the long periods of immobilization which may be given under proper precautions without detriment to inflamed and sometimes to healthy joints, the ankylophobia so prevalent among manipulators and general surgeons seems quite groundless. Let undue swelling and distention be reduced by local massage in proper cases, and then let passive movements as a rule be postponed until the reparative process is well advanced or the inflammation has subsided, using retentive apparatus without fear, when anything is to be gained by rigidly keeping the parts at rest. In acute and chronic joint troubles the secondary atrophy should not claim too much attention; it will disappear after inflammation has subsided, or the mechanical impediments to motion have been removed.

M. Castex's experimental studies on the effects of massage in *affections of the joints and muscles* deserve to be quoted. According to Graham, Castex studied the effect of massage in—

1. Contusions upon a limb at a distance from a joint, and in contusions upon the joint.

2. Sprains of the wrist, ankle, and neck.
3. Dislocations of the shoulder.
4. Fractures, some of which were "masséed" from the first, and others (more serious) after a certain period during which they wore a fixed dressing.
5. In muscular atrophies of diverse origin.

Excellent results were obtained in all these affections. Contusions of joints, when treated from the first with massage, were quickly relieved and serious consequences prevented. In old cases of *muscular atrophy* subsequent to joint injuries no muscular development followed. M. Castex severely bruised the corresponding muscles in each leg of some dogs, the joints in others, sprained the same joints in each leg of some dogs, and dislocated and fractured them in others. He always chose the most injured limb for massage, and the other had no massage, but was left to the natural evolution of the injuries. The effects—immediate, consecutive, and remote—were carefully noted in the presence of competent observers, who were not told which leg had been "masséed." The experiments were made in the laboratory of Professor Richet. The dogs were kept for five or six months and then killed, and the muscles, vessels, and nerves of the regions that had been injured, and also the corresponding parts of the spinal cord, were examined under the microscope.

The massage was done either immediately or very soon after the injuries; in the cases of the dislocations, also, as soon as they were set, and always with marked relief to the swelling, pain, and stiffness—so much, indeed, that after a few *séances* the dog had full use of the leg that had been "masséed," whereas the leg that had not been thus treated remained swollen, stiff, and lame for a long time. The two shoulders of a large watch-dog were dislocated by inward flexion. The head of the humerus of each was plainly visible under the skin, showing a luxation forward and inward—intracoracoid. They were easily reduced by traction. Massage was at once given for five minutes to the right shoulder, and after this a figure-of-eight bandage was applied to both. The massage was repeated daily. For the next three days the dog moved with difficulty. The right shoulder was still painful to the touch, but the dog stood firmer on that side. On the fourth and subsequent days pressure of all sorts upon the "masséed" shoulder was borne without pain, but when the other shoulder was pressed the dog growled and attempted to bite. Six days after the dislocation he supported himself well on the "masséed" limb, but held the other up, and the "non-masséed" shoulder was swollen and painful. On the eighth day the dog walked well with the right limb, but held the other up. The latter was still swollen and painful, and there was some crepitation in the joint. Thirteen days after the injury the dog took only an occasional step with the left limb, and two months later was in about the same condition, while he made free use of the right in walking and running. Dr. Graham, who reports these experiments, remarks that "evidence in favour of the early use of massage in dislocations, while being careful not to disturb the joint, is gradually accumulating." Passive movements should not be given until the patient has discovered that he can make a little voluntary motion.

Although massage has been highly recommended in the treatment of *lateral curvature of the spine*, it occupies a secondary position in the treatment of this affection; the best orthopædic practice relies more on posture, remedial exercises, and mechanical treatment. In the mild cases properly directed exercises and scrupulous attention to hygiene in its broadest sense usually suffice. Massage with enforced recumbency may, however, render important service in congenital or rhachitic cases, which are of exceeding difficulty.

Massage of the eye has been recommended in *asthenopia*, in *chronic inflammatory processes of the anterior segment*, for *embolism of the central artery of the retina*, and for *cataract*. Massage of the ear has been used for *deafness*, for the *dislodgment of foreign bodies*, and for *chronic catarrh of the middle ear*. Massage of the internal ear is also applied by exposing it to vibrations of selected pitch and intensity. In these affections it is clear that massage can be properly used only under the supervision of an expert. This is also true of its employment in other disorders. In order to do good, and even to avoid the possibility of harm, massage should stand on the same footing as other rational remedies, and be administered on the prescription and under the direction of a physician skilled in its use.—Henry Ling Taylor.

MASTIC, *mastiche* (U. S. Ph., Br. Ph.), is a concrete resinous exudation that is obtained by making incisions in the trunk and branches of *Pistacia Lentiscus*, a small tree that is a native of the countries bordering upon the Mediterranean. It occurs commercially in irregularly rounded, semi-transparent, yellowish granules, that may be agglutinated into masses, and which possess a slight terebinthinate odour and taste. It contains *mastichic acid*, $C_{20}H_{32}O_2$, *masticin*, $C_{20}H_{31}O$, and a volatile oil or terpene, $C_{10}H_{16}$.

It is used in preparing pills of aloes and mastic, the latter substance retarding the action of the aloes until it is in the small intestines. It is now rarely used internally, though once popular in the treatment of *diarrhœa*, *hæmoptysis*, etc. An ethereal solution is used by dentists to saturate small pledgets of cotton which are introduced as temporary fillings into *carious-teeth* cavities.

Samuel T. Armstrong.

MASTICATORIES are remedies to be chewed and not swallowed. Though medicinal substances are occasionally used thus, that a local action may be had upon the mucous membrane of the mouth—it is usually an astringent remedy or a demulcent remedy which is employed—the original purpose, and in fact the purpose ordinarily intended, is that masticatories shall provoke or augment the secretion of saliva. It is not necessary for this purpose that the substance chewed shall be medicinal, for the mere presence of a mechanical irritant in the mouth is sufficient to salivate, and if the

substance is masticated its effect is the greater. An example of the mechanical masticatory is to be seen in the much-chewed "gum," but if the substance is chemically a sialagogue the effect is heightened. Masticatories of medicinal character are generally acid, aromatic, or acrid in character.

The therapeutical use of masticatories is principally for the relief of *buccal dryness* caused by a deficiency of saliva, whatever may be its cause. They are, however, as a rule but palliative in their action and should not displace more radical and curative measures. That saliva when swallowed will have a stimulant action upon gastric secretion is true, for all alkalies will act thus, but that this action is wisely evoked by the use of masticatories is questionable (though the value of "gum" in dyspepsia is loudly proclaimed), and certainly the practice should not prevent the use of direct and more potent stomachics, especially the bitters.—Henry A. Griffin.

MATÉ, Paraguay tea (*thé du Paraguay*), consists of the leaves of *Ilex paraguaiensis*, a shrub of the holly family (*Aquifoliaceæ*), a native of Paraguay and other South American countries. It is largely used in South America as a substitute for tea, and is one of the few plants containing caffeine. It is therefore allied in its physiological properties to tea, coffee, guarana, and kola. Byanon found in it 1·85 per cent. of caffeine, but Peckolt found but 2·5 parts of caffeine in a thousand. It also contains from 12 to 15 per cent. of tannic acid, being in this regard similar to the other herbs of this class. Maté is but little used in this country, and is therefore obtained with difficulty in the ordinary markets. It appears in market in two forms—in the leaf and as a powder. In the first form the leaves are in small pieces, greenish in colour, of a somewhat agreeable odour, and of a distinctly bitter taste. It is prepared like ordinary tea and is used with sugar and milk. Maté in powder is used by pouring upon it boiling water, which is then sucked up through a tube having a bulbous end covered with a fine sieve. An infusion is sometimes made with boiling water, the powder being precipitated with cold water. The physiological effects are quite similar to those of tea, though less marked. The large proportion of tannin which it contains renders it decidedly astringent.—Floyd M. Crandall.

MATICO (U. S. Ph.), *maticæ folia* (Br. Ph.), is the dried leaves of *Piper angustifolium*, a plant growing in South America, and particularly in Peru. The drug has a feebly aromatic odour and an aromatic, bitter taste. Matico contains tannin, chlorophyll, colouring matter, a resin, a gum, salts, lignin, and a volatile oil; also, it is said, a peculiar bitter principle, *maticin*.

Upon the stomach matico acts as an *aromatic bitter*. Its chief value, however, resides in its *stimulant* action upon mucous membranes, especially that of the genito-urinary tract. Its action in this respect is similar to that of turpentine, but much weaker.

In *cystitis*, *leucorrhœa*, *gonorrhœa*, *menorrhagia*, *dysentery*, and *diarrhœa* it has been of considerable service, but it is in the subacute form of inflammation that it is especially to be employed. Many observers have extolled matico as a hæmostatic, and have recommended it in *epistaxis*, *hæmaturia*, *hæmatemesis*, and *hæmoptysis*. In these cases it is less active than turpentine. Matico has been used locally as a styptic, but its power thus to restrain bleeding is purely mechanical.

Of powdered matico the dose is from ½ to 2 drachms. The fluid extract, *extractum matico fluidum* (U. S. Ph.), is probably the best preparation. The dose is from ½ to 1 fl. drachm. The tincture, *tinctura matico* (U. S. Ph.), is given in doses of 1 fl. drachm. The infusion, *infusum maticæ* (Br. Ph.), is employed in doses of from 1 to 4 fl. oz.—Henry A. Griffin.

MATRICARIA (U. S. Ph.), or German chamomile, *flores chamomillæ* (Ger. Ph.), is the flowers of *Matricaria Chamomilla*, a European and Asiatic herb. The same properties are ascribed to it as to the ordinary chamomile, or anthemis, but it is less agreeable. It is rarely used out of the German-speaking countries, and is rapidly becoming obsolete. (Cf. Chamomile.)—Russell H. Nevins.

MATZOL.—This is an American proprietary mixture of equal parts of matzoon and cod-liver oil. It has been found to be well tolerated by the stomach in some cases in which the oil alone has not proved acceptable.

MATZOON is a variety of fermented milk prepared originally in Asia Minor. It is now made in the United States also. The indications for its use are the same as those for kumyss (*q. v.*), and the choice between the two products seems to turn upon the matter of flavour. To some persons matzoon is less disagreeable than kumyss, but to others it is more so.

MAY-APPLE.—See Podophyllum.

MECONARCEINE.—This name has been given by M. Laborde to a mixture of opium alkaloids exclusive of morphine, being those that are not soluble in ether. It is a white crystalline powder soluble in hot water and in dilute alcohol, but only slightly soluble in strong alcohol. According to M. Laborde, it is decidedly *hypnotic* and may be used in all cases of *insomnia*. Its action on the mucous membranes resembles that of morphine, and M. Laborde believes that it will be useful in cases where the *morphine habit* has been established, or where the prevention of that habit indicates the employment of some substitute. He recommends it in those forms of *bronchial* and *broncho-pulmonary affections* that are attended with *cough* and a *supersecretion of mucus*. In *neuralgia* he has used it, both hypodermically and as an external application.

Meconarceine may be given in daily amounts of from 0·092 to 0·385 of a grain.

MEDIATE TREATMENT.—By mediate treatment is meant the treatment of one individual through the agency of another. It is applied to treatment of the *fœtus in utero* or of the nursing infant by means of medicinal agents administered to the mother or the nurse.

That the fœtus may be affected by drugs taken by the mother does not admit of doubt. Iodide of potassium, the salts of mercury, and various other drugs pass readily from the maternal to the fœtal circulation. There can be no doubt, therefore, regarding our ability to influence the fœtus with drugs. It is equally certain that the fœtus may suffer from certain diseases. There are well-authenticated cases in which children have been born with variola, scarlatina, malarial disease, and other infectious diseases. It is, however, unnecessary and extremely unwise to attempt to treat a fœtus for any such condition. This is due to two reasons —uncertainty as to diagnosis, and uncertainty as to the effect of the drugs administered. In *syphilis* alone may treatment properly be instituted with the direct purpose of influencing the fœtus. The cure of the mother is also sought for, and the influence of the drugs upon the maternal organism is our only means of grading the doses. In this disease the favourable effects of treatment of the mother upon the fœtus can not be doubted. It is the mother, however, to whom the treatment must bé directed. The only safe means of relieving any supposed morbid condition of the fœtus is the removal as promptly as possible of any disease apparent in the mother.

Numerous drugs taken by the mother are excreted in the milk, and may be found upon examination. Ammonium salts, anise, and antimony are readily excreted, the latter so freely that it should be given with caution to the nursing mother. The same is true also of arsenic and atropine. Copaiba, oil of turpentine, and the various balsams are readily transmitted to the milk. Chloral quickly passes into the milk, but opium and morphine must be given in large doses to have an appreciable effect upon the infant. Iodoform, when used externally upon the mother, may be very quickly detected in the milk. Jalap, rhubarb, senna, scammony, sulphur, and various other cathartic drugs may also appear when given in free doses. The salts of lead, mercury, and zinc, while they have been discovered in the milk, are not transmitted so readily as some other substances. Iodide of potassium is very freely transmitted to the milk. It does not appear until after a considerable interval, but persists for twenty-four hours after the last dose has been administered. Castor oil quickly affects the milk, and the volatile and aromatic oils are almost as certainly transmitted to it. Salicylate of sodium increases the volume of milk, and is said to be dangerous when large doses are administered to the mother. But few drugs appear in the milk within less than three or four hours after they have been taken by the mother, but their excretion may continue for one or two days.

While all the drugs here mentioned have been discovered in milk by various observers, no definite rules can be given as to the transmission of any article taken by the mother. No two authorities agree and various tables differ widely. There seems to be a decided difference in this regard in different individuals. The character of the milk secretion has a most marked effect upon the excretion of these elements. In milk of good quality, which is a true secretion of the glands, the excretion of drugs and chemical salts is comparatively slight. In thin, watery milk, which is more of a transudation than a true secretion, such elements will readily appear. The amount of a drug which will be excreted by any given individual is therefore extremely uncertain. The futility of attempting to formulate definite rules is apparent. This is the chief objection to be raised against the treatment of the infant through its mother's milk. It is, in fact, a very serious objection—so much so that it makes treatment by this method impracticable and too uncertain to be relied upon. In *syphilis* alone is it possible to produce any marked effect upon the infant, and even here it is very uncertain. It must be understood that these remarks refer to the direct treatment of the child. There can be no objection whatever to the attempt to affect the child favourably by improving the mother's nutrition, for it is entirely reasonable to suppose that the improved general condition of the mother will have its effect upon the nursing infant. Mediate treatment is, on the whole, too uncertain in its results to be worthy of more extended attention.

Floyd M. Crandall.

MEIOTICS are agents which have the property of contracting the pupil. They are:

1. Preparations of physostigma. The alkaloid eserine is most frequently used, the sulphate being the salt preferred. It has been found that a solution of the strength of 1 to 800 is sufficient to produce some meiosis, while a considerably stronger solution must be used in order to affect the accommodation.

2. Pilocarpine, the action of which is in every way similar to that of eserine, except that a stronger solution is required to produce any effect—namely, 1 to 400. This alkaloid is ordinarily prescribed as the hydrochloride, which crystallizes easily and keeps for a long time.

3. Muscarine. This has been carefully studied by Krenchel, but the results of the experiments are by no means constant. It has the peculiarity, however, of affecting the accommodation before altering the size of the pupil. It is much less active as a meiotic than either eserine or pilocarpine, an instillation of a 1-per-cent. solution at least being necessary to produce much action. The effect also lasts but a short time, reaching its maximum in half an hour and disappearing in from one to two hours.

After being instilled into the conjunctival sac the meiotics, in solution, pass through the cornea like the mydriatics, acting then on the iris.

The actions of the meiotics are: First. To decrease the size of the pupil. This action is interesting in a laboratory experiment, but does not serve any particular purpose except in cases of *corneal ulceration* where a mechanical effect is desired, which will be referred to further on. It has been ascertained that, in spite of the use of very strong solutions, the

reaction of the pupil to light is not entirely abolished, and, indeed, when a sufficiently intense light is thrown upon one eye which has the pupil already contracted by a meiotic, the pupil of the other shows some degree of further contraction, although it has been already acted upon also by a meiotic. Another peculiarity of this action of the meiotics is that when the pupil is contracted by such an agent it is not always perfectly round.

Second. To contract the ciliary muscle. In accomplishing this, the near point is made to approach still closer to the eye. This is an effect not ordinarily desired for therapeutic purposes, but is interesting as affording data concerning the refraction and the elasticity of the lens. The spasm of the ciliary muscle produced by a meiotic is often attended by decided inconvenience to the patient, a sensation of drawing or tension in the globe, and not infrequently considerable ciliary injection, which lasts until the muscle begins to relax.

Third. The principal use of meiotics is in the treatment of *glaucoma* (see the article on MYDRIATICS). As it is necessary to use mydriatics with caution in this disease in any form, either actual or threatened, so in the meiotics we have a well-established class of agents for their treatment. It is beyond the scope of an article like this to consider the reasons why meiotics are of value in glaucoma; suffice it to say that, next to operative procedures, they are practically the only valuable agents for the treatment of this dread disease. The amount and frequency of the dose should be regulated to a great extent by the degree with which the disease advances.

Fourth. One other use of the meiotics remains to be mentioned. This is in the treatment of *corneal ulcer*. It is often a question as to just when a mydriatic and when a meiotic should be selected for the treatment of corneal ulcer. It is conceded, however, that when the ulcer is small and deep and situated near the edge of the cornea, solutions of a meiotic, properly used, are of more advantage than the mydriatics. This form of treatment has at least the advantage of mechanically preventing a prolapse of the iris in cases where perforation of the cornea occurs. If atropine is used, the relaxed iris falls back into the corner of the anterior chamber, and in the event of perforation protrudes readily through the opening. On the other hand, if the pupil is fully contracted, then, if perforation occurs, the iris is retained more firmly in its position.

LUCIEN HOWE.

MEL.—See HONEY.

MELILOTUS.—The leaves and flowering tops of *Melilotus officinalis* and *Melilotus altissimus*, herbs of the *Trifolieæ* found in southern Europe and western Asia, are official in the Ger. Ph. as *herba meliloti*. They contain coumarin. Melilotus is used only to impart a pleasant odour to medicaments.

MELISSA (U. S. Ph.), *folia melissæ* (Ger. Ph.), is the leaves and tops of *Melissa officinalis*, a plant of the *Satureineæ* indigenous to southern Europe, and now to be found in the United States. It is occasionally employed as a *diaphoretic* in *fevers*. The distilled water, *spiritus melissæ compositus* (Ger. Ph.), may be given in doses of from ½ to 2 fl. oz.

MENISPERMUM (U. S. Ph.) is the rhizome and rootlets of *Menispermum canadense*, yellow parilla, Canadian moonseed. It is used to a very slight extent as a substitute for sarsaparilla. The dose of the fluid extract, *extractum menispermi fluidum* (U. S. Ph.), is from ½ to 1 fl. drachm.

MENTHACETIC ETHER, *acetic ether of menthol*, $C_{24}H_{22}O_4$, is a liquid obtained by the action of nascent acetic acid on menthol. It is used topically like menthol as an *analgetic*.

MENTHA PIPERITA (U. S. Ph.), *folia menthæ piperitæ* (Ger. Ph.), is the leaves and tops of the plant of the same name, or peppermint, which is found wild in many parts of the temperate zones and is extensively cultivated for its oil. The bruised fresh leaves are a grateful and effective external application for the relief of *colic*, *rheumatism*, and other *painful affections*. A poultice of the fresh leaves, applied over the epigastrium, often allays *nausea*, especially that of *sick headache*, and mild attacks of simple *diarrhœa*. When used in this manner, the poultice should be covered with rubber cloth or oiled silk to retain the volatile constituents upon which the major part of the good effect depends. An infusion of 1 part of the dried leaves in 10 parts of hot water is used almost *ad libitum* in *colic*, *flatulence*, *dysmenorrhœa*, and all forms of *abdominal pain* and to promote the *menstrual flow*. Peppermint water, *aqua menthæ piperitæ* (U. S. Ph., Br. Ph., Ger. Ph.), is a convenient vehicle for offensive, nauseating, or griping medicines, and may be substituted for the hot infusion. Accumulations of *flatus* will generally be expelled by any of the preparations of this drug, especially in children. There seems to be a popular impression that the addition of sugar in this class of cases is desirable, but it should be avoided, as it tends to maintain the fermentative processes which have given rise to the formation of the gas. Peppermint water may be given in doses up to 1 fl. oz. The oil, *oleum menthæ piperitæ* (U.S. Ph., Br. Ph., Ger. Ph.), in common with all essential oils, when applied to the skin over *painful points*, has decided *analgetic* properties, and is used for such purposes in cases of *neuralgia*, *arthralgia*, etc. In *acute rheumatism* the joint pains are sometimes relieved by applications of the oil, especially when the parts are covered, subsequent to the use of the oil, with cotton, and over this sheet rubber or oiled silk is applied. For *toothache* a pledget of cotton wet with the oil and inserted into the cavity is very effective. Internally, the oil may be given in doses of from 1 to 3 drops, but is rarely used, for the other preparations of the drug are easier to take and just as efficient. To some the oil, more particularly than any of the other preparations, is *aphrodisiac*.

[Inhalations of the vapour of peppermint oil have been recommended in the treatment of

pulmonary tuberculosis, but Dr. Edward R. Baldwin, of the Saranac Laboratory for the Study of Tuberculosis (*N. Y. Med. Jour.*, May 18, 1895), concludes from extensive experiments that, although the oil may prevent the *Bacillus tuberculosis* from growing in a test-tube, its parasitic existence is not hindered by even constant inhalation of the strong vapour of peppermint; and that, although the oil has a high power of diffusion, its local antiseptic action in the respiratory tract is probably slight, both on the tubercle bacillus and other bacteria.]

The dose of spirit of peppermint, *spiritus menthæ piperitæ* (U. S. Ph., Br. Ph., Ger. Ph.), varies from 5 to 15 drops of the Ger. and U. S. preparations to from ½ to 1 fl. drachm of that of the Br. Ph. The term essence is generally used as synonymous with spirit, but the Br. Ph. orders a distinct preparation of this name, *essentia menthæ piperitæ*, containing 1 part of the oil and 4 parts of rectified spirit. The dose is from 5 to 15 drops. The dose of the syrup, *sirupus menthæ piperitæ* (Ger. Ph.), is from 1 to 2 fl. drachms. The *rotulæ menthæ piperitæ* of the Austr. and Ger. Ph's, the pastilles and troches of the Fr. Cod., and the troches, *trochisci menthæ piperitæ*, of the U. S. Ph. are essentially the same preparation, being in the shape of lozenges or drops, each containing about ¼ of a drop of the oil. They are used in *nausea* and *seasickness*, to remove *flatulence*, and to take away the bad taste in the mouth after disagreeable medicines have been given. One or two troches may be taken as a dose. Cf. MENTHOL.

RUSSELL H. NEVINS.

MENTHA VIRIDIS.—This is a widely distributed species of *Mentha*, more commonly known as spearmint, having the same properties as *Mentha piperita*, but in a much less marked degree, and on that account preferred for children and infants. The official preparations are spearmint water, *aqua menthæ viridis* (U. S. Ph., Br. Ph.); oil of spearmint, *oleum menthæ viridis* (U. S. Ph., Br. Ph.); and spirit of spearmint, *spiritus menthæ viridis* (U. S. Ph.). They are used in the same manner and in the same doses as the corresponding preparations of *Mentha piperita*. Several other species of *Mentha*, especially *Mentha crispa*, are used in medicine and have properties similar to those of the species already mentioned.

RUSSELL H. NEVINS.

MENTHIODOL.—See under MENTHOL.

MENTHOL (U. S. Ph., Br. Ph.), *mentholum* (Ger. Ph.), is a crystalline body, sometimes denominated peppermint camphor, having a strong odour of peppermint, from the oil of which it is obtained. It is freely soluble in nearly all the ordinary menstrua except water, and when applied to the skin in any form causes a varying amount of pain, followed by a sense of coldness and a loss of sensation in the skin and parts immediately beneath it. Compressed into cones and pencils, it has been largely employed as a local application for the relief of *neuralgic* and other *pains*, but whenever the pain is severe it is of little value. It, however, works very well in mild *facial neuralgia* and *headache*. Alcoholic solutions or ointments of the strength of 10 per cent. are very useful in all forms of *pruritus*, the ointments being preferable when the applications are to be made to mucous surfaces. The itching of *urticaria* and the irritation caused by the *bites of insects* are also usually benefited by the same preparations. Injection into the nose of 10-per-cent. solutions, oil or vaseline being a better medium than alcohol, in *hay fever* and *nasal catarrh*, has been practised extensively and with good results. Internally, menthol may be given in doses of from 3 to 5 grains in capsules for the relief of *nervous dyspepsia* and *diarrhœa*, but is palliative rather than curative. Menthol plaster, *emplastrum menthol* (Br. Ph.), is a moderate counter-irritant and is useful in mild forms of *neuralgia*.

[Menthol may often be used to advantage as a *local anæsthetic*. According to Dr. Squibb (*Ephem. of Mat. Med.*, etc., Jan., 1896), local anæsthesia that will last for about five minutes may be produced by spraying the part with the following solution, using an ordinary hand-bulb apparatus:

Menthol..................	2 parts;
Chloroform...............	20 "
Ether....................	31 "]

Menthiodol is a mixture of 4 parts of menthol and 1 part of iodol, usually moulded into cones or pencils, and used for the same purposes as menthol itself.

Equal parts of menthol and chloral furnish, upon trituration, an oily substance which is a mild *counter-irritant* and *local anæsthetic*.

[Dr. Squibb (*Ephem. of Mat. Med.*, etc., Jan., 1894, Jan., 1895) gives the following formulæ for the use of menthol in the *vomiting of pregnancy*:

1. Gottschalk's formula:

Menthol................	1 part;
Alcohol................	20 parts;
Distilled water....	150 "

2. Weiss's formula:

Menthol................	1 part;
Alcohol................	20 parts;
Syrup............... ...	30 "

3. Weil's formula:

Menthol................	1 part;
Olive oil...............	4 parts.

Dose, 10 drops, with powdered sugar.

4. Menthol................ 40 grains;
   Oil of bitter almond...... 180 "

From 6 to 10 drops to be given on a lump of sugar.

Dr. J. Walker Downie (*Brit. Med. Jour.*, Apr. 18, 1891) has obtained very satisfactory results from intralaryngeal injections of a solution of from 10 to 15 per cent. of menthol in olive oil or vaseline in certain *laryngeal* and *pulmonary affections*, particularly *pulmonary tuberculosis* and *ulceration of the larynx*. Dr. Downie uses a hypodermic syringe fitted with a hard-rubber nozzle for the purpose of giving these intralaryngeal injections, and he generally employs a laryngeal mirror, in order to guide the point of the syringe over the epi-

glottis and thus prevent retching. The nozzle, he says, should reach at least as far as the vocal cords, for if the liquid is spread over the cords the sensation is very disagreeable. "If, however," says Dr. Downie, "the nozzle of the syringe be placed below the level of the cords, the fluid is injected directly through the larynx into the trachea, and as much as two drachms in some cases can in this way be injected without the slightest inconvenience to the patient. An ordinary hypodermic syringe holds from 25 to 30 minims, and, in using it with the laryngeal tubes spoken of, I repeat the injection two or three times at each sitting, thus giving roughly from a drachm to a drachm and a half. Applying it in this gradual way, I never have patients coughing as they did when the same quantity was given at one injection by means of the large syringe." The patient at once feels a sensation of warmth in the larynx, which rapidly spreads downward to the region of the sternum and is soon followed by a comfortable glow all over the chest. Any feeling of tightness or constriction that may have been present is rapidly relieved, and the breathing becomes freer; there is much less inclination to cough, and often the relief from the tickling is very decided, especially after the treatment has been followed for a few days. Many patients do not cough at all for from four to eight hours, or even longer, after the injection, and, if it is given at bedtime, those whose sleep has before been much interfered with have a fair prospect of sleeping all night without once coughing. In tuberculous cases the expectoration is diminished, and, owing probably to the fact that a proper amount of sleep is afforded the patient without deranging his digestion, he often gains in weight.

Dr. Downie gives his conclusions as follows: "Regarding the action of menthol specially, when thus employed, I think we may consider it to be of a triple character. It is, first, a local anæsthetic. On account of this property we have relief from cough, and that in a way greatly to be preferred to the older fashion of administration of opiates by the stomach, with their consequent deleterious effects on alimentation. Secondly, administered internally, it is a powerful though comparatively harmless stimulant. Thirdly, it is an antiseptic, and, being of a high volatile character, it is readily diffused throughout the whole lung. By its use in this fashion, we have an antiseptic brought as closely into contact with the affected surface as it is possible—certainly much more completely than is the case where inhalers are employed. The active ingredient used with an inhaler is to a very large extent absorbed on its way to the lungs by the moisture on the surface of the tongue, cheeks, fauces, pharynx, etc. Here we place the antiseptic—menthol rendered more powerful by the addition of creosote or guaiacol—within the trachea, from which it readily enters the larger bronchi, and all air inspired, passing over this, becomes laden with the antiseptic, and is carried onward to the finer ramifications of the bronchi. The active ingredients thus introduced slowly volatilize, and their odour, especially when creosote is present, may readily be detected in the breath eight or ten hours after introduction. The oil, I suppose, is partially absorbed, but in greatest quantity is, by the cilia of the epithelium, driven upward through the bronchi and trachea along with the mucous secretion toward the larynx, from which it readily enters the gullet. By this form of treatment the majority of the patients whom I have seen treated have had their sufferings alleviated, and a goodly proportion have not only been markedly relieved, but restored to apparent health."

In the *Practitioner* for October, 1894, Dr. Frederic C. Coley corroborates Dr. Downie's observations, and says: "The laryngeal syringe should have a delivery tube with a single terminal opening, not a number of minute lateral openings as in most laryngeal syringes which I have seen. The syringe which I use has a glass barrel and a delivery tube of vulcanite; but a silver delivery tube might be preferable. The syringe should be capable of holding a fluid drachm, which is the largest amount which I have found it expedient to inject at one sitting.

"The point of the syringe should be guided, by the help of a laryngoscope, into the upper part of the larynx. It is not necessary to insert it between the vocal cords; it is quite sufficient to get it past the epiglottis. From ♏xx to ʒss. of the solution is injected at once. After a pause of two or three minutes this may be repeated. If there is any tendency to cough, the patient should be told to repress it; and usually there is little difficulty in doing so, provided the injection has been neatly managed. It is obvious that the dexterity which can only be acquired by practice has much to do with the success of this method of treatment. When I first made use of it I occasionally produced a very troublesome fit of coughing like that which takes place when some liquid is swallowed the wrong way. This has scarcely ever happened to me lately. A great point is to see that the patient is making deep respirations while the injection is being given. This secures the wide patency of the rima glottidis, which is necessary for the satisfactory descent of the solution into the trachea.

"The syringe should not be completely emptied when the final injection is made. Then the extrusion of the few drops of solution remaining serves to prevent any trace of mucus from being allowed to occupy the lumen of the delivery tube. This should be first carefully wiped with dry cotton-wool (to be burnt immediately, of course), and then with cotton-wool wet with carbolic acid and glycerin in equal parts. The tube should then be dipped in the same and left wet with it. This appears to me the best method of sterilizing the syringe after use, the necessity of which must be obvious. . . .

"The dyspnœa of phthisis is often relieved in a very striking manner by these injections, and the relief from cough often lasts for two or three days. The rest and sleep which are

thus secured (without the drawbacks which attend the administration of sedative cough mixtures) are a material help to the patient in the struggle against the disease; and in some cases there appears to be a direct effect upon the local morbid processes. Any patient who is able to tolerate an ordinary laryngoscopic examination can bear these injections, provided they are administered with a reasonable degree of expertness."

In the Otological Section of the Sixty-sixth Congress of German Naturalists and Physicians, held in Vienna in September, 1894 (*Mntsschr. f. Ohrenheilk.*, Oct., 1894; *Jour. of Laryngol., Rhinol., and Otol.*, Jan., 1895), Dr. Szenes, of Buda-Pest, related his experience in the use of menthol in diseases of the ear. He said that for five years he had been using 10- and 15-per-cent. solutions of menthol in oil, and had used them in a hundred and fifty cases. He recommended the mentholized oil in the treatment of *furuncle of the external auditory meatus* and of diffuse swelling of the wall of the canal. His practice was to place a pledget of wool, soaked in the mentholized oil, in the meatus and leave it there for twenty-four hours. This produced a burning feeling which generally soon passed off, but sometimes lasted for several hours. This treatment, he said, was most suitable after incision of the furuncle and the removal of its contents with the sharp curette; the process of healing was very much shortened, and in many cases recurrence was prevented. Narrowings of the external meatus brought on by furuncle or *diffuse otitis externa* usually disappeared completely or became very much diminished in the course of twenty-four hours.

At the same meeting Dr. Gompertz recommended the use of menthol in simple *otitis media* without perforation. In the painful stage he had observed the decided anodyne and antiphlogistic action of a 1- or 2-per-cent. solution of menthol in oil, especially white vaseline oil, instilled into the meatus. He had found also that a 5- or 10-per-cent. oily solution was very valuable as a mild antiseptic for the interior of the tympanum in *chronic suppurative otitis media*. Cf. MENTHO-PHENOL.

RUSSELL H. NEVINS.

MENTHO-PHENOL. — In the *Boston Medical and Surgical Journal* for January 30, 1896, Dr. Theodore W. Schaefer, of Kansas City, in an article on Certain Chemical Compounds Obtained by the Union of Phenol Derivatives with the Isomerides and Polymerides of Camphor, says that mentho-phenol is obtained by adding 1 part of phenol to 3 parts of menthol and then melting the mixture. A transparent liquid is obtained, having an aromatic odour and taste. Applied to the tongue, it produces a temporary anæsthesia similar to that of cocaine, although not so lasting. Mentho-phenol is nearly insoluble in water and in glycerin, but readily dissolves in alcohol, in ether, in chloroform, and in most of the light and heavy oils. It dissolves iodine, iodoform, and aristol. It is *antiseptic* and has strong *analgetic* properties. It may be used preparatory to cauterizing chancroidal sores and curetting necrotic surfaces. As a mouth wash, it may be used with advantage, 2 drops being mixed with an ounce of the aqueous menstruum.

Dr. Schaefer says that his brother, Dr. Edward H. Schaefer, has recently investigated the therapy of mentho-phenol. He has employed it in *chancroidal sores* of the penis. In a case of *phagadænic chancroid*, where there seemed to be imminent danger of sloughing of the entire glans penis, the frequent use of ablutions of warm water mixed with mentho-phenol (3 per cent.) soon stopped the destructive process and established resolution. He employed the agent in *mucous patches*, syphilitic in character, making daily applications of mentho-phenol, which resulted in the healing of the abrasions.

In a case of *facial erysipelas* in which the submaxillary and cervical glands were threatened by a destructive suppurative process, the daily syringing of the suppurating tracts with warm water mixed with 3 per cent. of mentho-phenol soon resulted in a subsidence of the suppuration. The most admirable results he obtained in a case of *abscess* under the finger nail, the result of traumatism. The finger was dipped in warm water mixed with mentho-phenol (5 per cent.). A lancet was plunged deep under the finger nail into the abscess, and the patient uttered no cry or made any demonstrations indicative of pain. The patient stated that the pain had ceased like magic when the finger was immersed in the warm mentho-phenol mixture. The finger was dressed with gauze rendered antiseptic with 2 per cent. of mentho-phenol and healed in a few days.

In a case of *suppurative otitis media et interna*, accompanied with great pain and throbbing, an offensive purulent discharge created an eczematous eruption in the vicinity of the outer ear. The frequent syringing of the auditory canal with very warm water mixed with mentho-phenol soon checked the suppurative, inflammatory process, and resulted in the disappearance of the eczema. In a case of *foreign body in the ear*, in which a small insect had crawled into the ear of a lady, a warm mixture of 2 per cent. of mentho-phenol produced the insect, to the great satisfaction of the patient. *Wounds*—incised, punctured, lacerated, etc.—says Dr. Schaefer, will heal kindly when cleansed with warm water mixed with 2 per cent. of mentho-phenol.

In dental practice mentho-phenol finds its indications, as an anodyne anæsthetic, in *odontalgia*, obtunding the sensitiveness of dentin, and as an antiseptic in *alveolar abscess, suppurating pulps of teeth, periodontitis*, etc.

Having thus recounted his brother's experience, the author says that he himself has used the medicament in *pustular acne*. The pustules, he says, may be opened without causing much pain after having been first touched with vaseline containing 5 per cent. of mentho-phenol. Mentho-phenol mixed with almond oil or alcohol, in the proportion of 2 per cent. of the medicament, he has used as an external application in *itching* of the skin.

He has never used it subcutaneously or by the mouth. It can not be used in ophthalmological practice, he says, on account of the unpleasant burning which follows its use when applied to the conjunctiva.

MERCURY, *hydrargyrum* (U. S. Ph., Br. Ph., Ger. Ph.), quicksilver, is a lustrous, silver-white metal which is liquid at ordinary temperatures. At $-38{\cdot}88°$ F. it becomes solid and is then malleable and ductile. At $675{\cdot}05°$ F. it boils and is completely volatilized, the vapour being colourless and very poisonous. It is slowly volatilized at ordinary temperatures and more rapidly as the temperature rises. Mercury is easily divisible into spherical globules. It has neither odour nor taste. It is soluble in nitric acid and in boiling sulphuric acid. Although mercury is found pure in nature to a limited degree, and to some degree also amalgamated with silver and as native mercurous chloride, it is chiefly obtained as a sulphide. This sulphide, or *native cinnabar*, as it is called, is found in various parts of the world, but is especially abundant in Spain (at Almaden) and in California (at New Almaden), whence by far the largest amounts are obtained. The processes by which mercury is separated are several, but in each case the action is a distillation.

So far as a physiological action is concerned, mercury itself is inert, and, though physiological and therapeutical phenomena result from its administration in fine subdivision, these can not be regarded as evidences of the activity of the metal itself, for in this minute division it is in a favourable state for chemical combination, and it seems probable that in the stomach and intestines such combinations do occur. The apparent activity of metallic mercury is thus explained, for that its salts are active is undoubted. Combination and absorption will also, to some degree, result from the administration of the remedy in bulk, provided it remains in the intestines for a time sufficiently long, but as this use in bulk is seldom resorted to, its activity is rarely exhibited. Formerly, indeed, metallic mercury was given to cause purgation, especially in cases of intestinal obstruction, and this it accomplished by virtue of its weight. In such cases a pound or two of the remedy was administered, and though combination and absorption of a portion may have resulted, the stay of this amount of mercury in the intestine was not likely to be long enough to cause decided physiological phenomena. What is true of mercury when given internally is also true of it when applied locally. Its mere application to the skin is without result, but its prolonged application in a state of minute division is followed by its absorption and the production of physiological effects. Vaporized mercury is also absorbed from the pulmonary mucous membrane, and indeed the continued handling of mercury, even at the ordinary temperature, may be the cause of absorption sufficient to cause severe poisoning. This will be considered further on.

Apart from the physiological actions peculiar to the various combinations of mercury, there are certain physiological effects which they, together with mercury itself, possess in common. These effects will first receive consideration, and subsequently the actions peculiar to the salts will be discussed in the individual consideration of the combinations of mercury. The rapidity with which mercury is absorbed will vary with the preparation employed and the method of its administration. It has been observed in the urine in fourteen hours after its application to the skin and in an hour after its subcutaneous injection. The metal itself and many of its combinations, when absorbed into the blood, exist in that fluid probably as an albuminate. By the blood mercury is carried to all parts of the body and is demonstrable in every part and every tissue. It has been found in all the secretions—not only the normal ones, but pathological ones as well—but its main elimination is in the urine. The salivary glands and the intestines, however, in some cases are active eliminators of mercury. It is maintained that, while a single dose of mercury is rapidly eliminated, the discharge of mercury from the body of one who has undergone a mercurial course ceases before elimination is complete and may be re-established by the administration of potassium iodide. However this may be, it is certain that the elimination of mercury which follows its prolonged use as a remedy is exceedingly slow. In leaving the body through the kidneys the mercurial preparations—the mild as well as the irritant—may be the cause of serious renal inflammation if they are sufficient in amount or if their use has been long continued.

The systemic action of mercury is as inexplicable as it is certain. If very small doses are given and are not too frequently repeated, mercury will act as a *tonic*, increasing the weight and vigour of the body, and causing a greater production of red blood-cells. That this action is greater in cases of *anæmia* and *debility* due to syphilis is unquestionable; but here its action is antidotal rather than tonic, and its corroborant power is certainly manifested in other anæmias as well. Its action is therefore comparable with that of iron in result, though not in manner. How this tonic action of mercury is to be explained is unknown; it has been suggested that it is due to a prevention of waste rather than to an augmentation of construction, but this proposition rests on theoretical grounds alone; it is certain, however, that, properly given, mercury is a tonic of much value. The result is far different from the prolonged administration of considerable doses, for then there result a diminution of the number of red blood-cells, an increase of the watery constituents of the blood, and a lessening of its plasticity from diminution of its albuminous and fibrinous constituents. Moreover, there then accumulate in the blood a number of effete materials whose composition is unknown but whose nature is fatty. Mercury possesses in an extraordinary degree the power described as *alterative*—that is, it has a pronounced influence over nutrition, whether normal or pathological.

The nature of its alterative power is unknown, but it is intimately connected with the glandular apparatus of the body and the emunctories. The remedy promotes the activity of all glandular structures, and the secretions are increased in amount, almost without exception. The lymphatic or absorbent system, too, becomes more active under the influence of mercury, and thus there result from its use a removal of *morbid exudations*, *enlargements*, and *indurations*, and a subsequent elimination of the matters which have been absorbed. Of the secretions which mercury augments, the bile is of much relative importance. Opinions differ as to the action mercury exerts upon the liver and its functions, some maintaining that the mercurials, as a class, and especially calomel, exert a quieting action upon hepatic function and diminish the production of bile. This belief seems at variance with clinical and experimental evidence, and the larger number of authorities regard the preparations of mercury as indirect *cholagogues*—that is, remedies which, by virtue of their duodenal purgation, cause mechanical emptying of the bile ducts, and hence increase the discharge of bile without increasing its production. One mercurial, however, is truly and directly a cholagogue, and that is corrosive sublimate, one of whose actions it is to increase the production of bile. To this the experiments of Rutherford bear abundance of testimony. The intestines are directly stimulated by the action of mercurials, the glandular secretions being increased in amount, and peristaltic movement being excited. Further than the direct intestinal stimulation which follows the administration of a purgative dose of mercury, and which is unaccompanied by any considerable absorption of the metal, it is well known that mercury which has been absorbed is partially eliminated through the intestines, as are the products of the tissue waste which mercury causes. In this way, too, the intestinal activity is stimulated. The pancreas seems to be more active under the influence of mercury, and, indeed, this is quite what might be expected when we realize the similarity which exists between the pancreas and the salivary glands and know the activity of mercurial preparations upon the latter. Certain it is that when mercury has been given in large doses there may occur a discharge from the intestine of a considerable amount of fluid resembling saliva, and post-mortem examination has demonstrated the presence of congestive changes in the pancreas. The power which mercury has over the action of the salivary glands is one of its most prominent characteristics, and the salivation which results from the overuse of mercury is well known. The more detailed consideration of mercurial salivation I shall postpone until I come to speak of mercurial poisoning, of which salivation is the most prominent phenomenon. The action of mercury upon the kidneys is often pronounced, and calomel is frequently employed as a *diuretic*, either alone or combined with digitalis and squill. It is uncertain how this diuretic action is evoked, for, though many theories have been advanced to explain it, none is altogether satisfactory. The use of calomel for diuretic purposes in renal diseases is fraught with the danger of mercurial poisoning, and many have become distrustful of the remedy because of this ill result from its use. To account for this special liability to mercurial poisoning in renal disease by the condition of the blood which results from albuminuria is far-fetched, and the danger is more rationally explained by the deficient elimination of mercury through kidneys which are diseased. The nervous disorders which mercury provokes are of almost limitless variety, but these are toxic manifestations which will be considered further on.

When mercury is given to cause either tonic or alterative effects it is administered in small doses and at infrequent intervals. Under these circumstances there seldom occur any manifestations of its presence in the body beyond the amelioration of the disease. When a single purgative dose of a mercurial is given the same thing is true; purgation takes place, elimination of the mercury is completed, and no further manifestations of its presence in the body are met with. If, however, there is a continued absorption of mercury in sufficient amount, either because of undue size of dose or of undue frequency of administration, or if elimination is interfered with, or if an idiosyncrasy of the individual exists, there occur evidences of the presence of mercury within the body which are pathological. The earliest of these symptoms are a disagreeable, metallic taste in the mouth, a fœtid odour of the breath, and some slight soreness of the teeth, elicited upon forcibly closing them together. These phenomena are warnings of the overaction of the drug and should be sought for and heeded; and, though it is permissible to continue the use of the remedy beyond this point, it is seldom thought desirable at the present time; formerly, however, the therapeutic efficiency of mercury as an antisyphilitic was believed to be fully developed only when pronounced salivation was observed. If the use of the remedy is persisted in beyond the point described, the saliva is much increased in amount and the gums become swollen, spongy, and bleeding. These effects must limit the employment of mercury in all cases. A persistence in its use beyond this point results in an aggravation of the symptoms already observed; the saliva is enormous in amount, as well as thickened, and runs from the mouth continually; the gums are greatly swollen and bleed much; the tongue is increased in size, it may be very greatly; the teeth become loosened; the entire cavity of the mouth is congested and sensitive; and there are swelling and tenderness of all the salivary glands. There may also occur sloughing of parts of the mouth, gangrene, loss of teeth, severe hæmorrhage, and necrosis of portions of the maxillary bones. If the phenomena of *mercurial poisoning* have reached this gravity, death may well result, and even if recovery occurs it is only after tedious and prolonged convalescence, for a considerable amount of constitutional disturbance accompanies these local manifestations. Thus, even with the

earlier symptoms of mercurial poisoning there may be noticed a general irritability, with increased pulse-rate and some rise of temperature. In the severer cases nutrition suffers considerably, emaciation and anæmia may become extreme, and death result from exhaustion. Ulcerations of the skin may also be observed, as well as alopecia, eczematous eruptions, and a diarrhœa of fetid character. This acute form of poisoning is referred to as *acute mercurialism*, and, because of its most prominent symptom, is also called *ptyalism* and *salivation*. The treatment of acute mercurial poisoning should be prophylactic, and the suspension of the use of the drug should follow promptly upon the discovery that soreness of the teeth exists or that the saliva is to any degree increased in amount. If ptyalism is established, astringent and cleansing mouth washes are to be employed, solutions of boric acid, potassium chlorate, and carbolic acid being appropriate. In the severer forms of ptyalism it is recommended to use dilute solutions of chlorinated soda or chlorinated lime, weak solutions of silver nitrate, or lead water. Atropine given internally may also prove beneficial.

Occasionally it happens that certain individuals manifest symptoms of the poisonous action of mercury, not in the usual way, but by circulatory weakening, præcordial distress, pallor, nervous irritability, and exhaustion. With the appearance of these symptoms the administration of mercury should cease.

When the absorption of too great an amount of mercury follows the inhalation of its vapour, as may happen to those who handle mercury habitually, though in such cases cutaneous absorption doubtless plays a considerable part, there may occur a different train of symptoms, and to these collectively the name *mercurial cachexia* is applied. In such cases are seen anæmia, loss of flesh and strength, rheumatic and neuralgic pains in various parts of the body, diarrhœa and various disturbances of secretion, loss of hair, swelling of the limbs, and a variety of nervous disturbances. Exceptionally such a state may follow the medicinal use of mercury if long continued. The nervous disturbances observed in these cases are of the greatest variety, but tremors and paralyses are especially common. The tremors resemble those of paralysis agitans; sometimes they are rather startings than tremors, and may be like the movements of chorea. They affect the extremities and the face in particular, and seriously interfere with voluntary movements of the parts. The paralysis of chronic mercurial poisoning may be a monoplegia or the affection may be extensive. Anæsthesia also may occur and is of variable extent; it is rarely absolute, however. The special senses may be impaired, neuralgia may occur, epilepsy has been seen, and even permanent insanity has taken place. These nervous symptoms of chronic mercurial poisoning may, it is said, result from a single exposure to the inhalation of mercurial fumes. The pathological cause of these nervous phenomena is a destructive influence which the metal possesses over nerve protoplasm, a power it has in common with others of the metals, notably lead and arsenic. Like them, too, mercury is competent to produce the degeneration of visceral cells.

The therapeutics of mercury may be separated into several divisions. As a *tonic*, mercury may be given in small doses, not frequently repeated, to the end that nutrition may improve and the cellular richness of the blood increase. This employment of mercury as a systemic tonic is not a common one, apart from its use in the anæmia which syphilis produces, but, though the hæmatinic action is doubtless more manifest in the syphilitic, there often will result a considerable improvement in ordinary forms of *anæmia* from the judicious administration of a mercurial, especially corrosive sublimate.

As indirect *cholagogues* and *digestive stimulants*, calomel and mercury with chalk may be advantageously employed. *Biliousness* may thus receive benefit, and not that form alone in which bile is deficient, but that as well in which its production is unduly great. In *intestinal dyspepsia*, too, these preparations may be of service, as in *diarrhœas* of certain varieties. In various other conditions which may be digestive in their causation, and perhaps hepatic, these preparations may be of service. Of such conditions *rheumatism*, *gout*, and various *skin diseases* are examples. Corrosive sublimate may be employed with particular success in cases where the secretion of bile is deficient, but the action in this case is truly and directly cholagogue, as I have already said.

As purges, the mercurials, calomel and blue mass, are in constant employment, but the detailed consideration of their uses will be reserved until these preparations are individually presented.

As *antiphlogistics* (*antiplastics* would be the better word) the mercurials are no longer employed to the same extent as they were in former years, but nevertheless they are to some degree given for their action as such even at the present day. It is in *inflammations of serous membranes* that they are particularly useful, as well as in *iritis*. They are only to be recommended in case the exudation is fibrinous and the disease sthenic. Given early and before exudation is complete, the mercurials will tend to diminish fibrinous exudation, and their continued administration will lessen the tendency to the organization of the exudate and promote its absorption. The reason for this practice lies in the belief that the administration of a mercurial, if continued, will diminish the amount of fibrin the blood contains, and hence will reduce its plasticity. Under this belief the therapeutics of former years required that a patient thus treated should be kept in a condition of misery from salivation, but, while it is no doubt true that under these circumstances absorption and elimination are more rapid, the practice is accompanied by manifest disadvantages. For this reason the antiphlogistic use of mercurials at the present day is limited to the production of the least of buccal symptoms, and nothing is permitted beyond the slightest soreness of the teeth and the metallic taste in the mouth.

To guard against the production of diarrhœa by the prolonged employment of a mercurial remedy, it is wise to combine the drug with a small amount of opium. That the continued use of mercury may be antiphlogistic is credible, but that the single purgative dose of calomel or blue mass which is given so often at the invasion of acute inflammatory diseases is active by virtue of antiphlogosis in the antiplastic sense is not to be believed.

[Dr. William Murray (*Lancet*, Sept. 28, 1895) says that repeated observation has convinced him that in *heart diseases* mercury possesses a value far beyond the supposed alterative nature of its action—not, he says, that it fails to relieve congested vessels by drainage or osmosis, for doubtless this lays the foundation of its further action on the heart itself, and it would fail to relieve the heart did it not eliminate biliary and other effete matter from the blood and tissues of the liver and portal system, for instance; but when due allowance has been made for these primary effects there remains strong evidence that it tells upon the heart itself. Its special benefits are exercised in cases of *dilated* and *hypertrophied heart*. By means of it the thready, weak, rapid, and irregular pulse is made full, soft, regular, and slow, with manifest relief of such symptoms as dyspnœa, pectoral weight and tightness, and sensations of faintness. The *angina sine dolore*, he says, is often marvellously relieved and removed by 2 or 3 grains of blue pill three times a day, and the severe forms of *angina pectoris* not infrequently disappear under its influence, which is more lasting than that of the nitrites, nitroglycerin, etc., which afford only temporary relief. To give digitalis a fair chance, says Dr. Murray, it is absolutely necessary to pave its way by preliminary doses of mercury and to foster its action by repeated doses. Many of the cases where digitalis, etc., fail, or seem to fail, by supposed accumulation depend, he says, on this: that we are giving digitalis without the blue pill or calomel, and it often falls to the lot of the consultant to make a great hit by adding the use of a mercurial to the previous treatment. Still more, says Dr. Murray, is this true of iron and digitalis combined. We see a patient, he says, with engorged vessels and labouring heart taking iron and digitalis much to his detriment—each dose is but adding fuel to the fire—energizing the heart in its futile attempts to drive the blood through the engorged vascular system, and thus exhausting the organ in its hopeless struggle. All this is changed by frequently repeated doses of mercury; the portal system is drained, the water from the general vascular system is "exosmosed," dropsical accumulations are absorbed, and by pushing the drug we get hold of the heart itself and produce the slow, soft, regular, and effectual pulse, giving the digitalis or strophanthus a fair chance to come in as cardiac tonics; and at last we complete the circle by arriving at the point whence we departed with the patient in a very different condition, and we can give the iron and digitalis now with impunity—nay, with immense benefit. The question, says Dr. Murray, naturally arises, How does it act? Is it a cardiac tonic, stimulant, alterative, or what? Does it act on the secondary apparatus of the circulation and the blood itself by reducing the resistance of the vessels, diminishing the volume of blood, and altering its fibrinity so as to make it circulate more freely? Dr. Murray thinks that it does produce these effects, and, at the same time, that it soothes the heart by purifying the blood of effete accumulations.]

As an *antisyphilitic* mercury has been more highly esteemed than any other drug. That it is not necessary in all cases of *syphilis* is true, but it is equally true that in many cases it is indispensable. As to the propriety of administering this remedy in the first stage opinions differ, some maintaining that the mere induration of the primary lesion should afford proof enough of the syphilitic character of the case and indicate the immediate beginning of a mercurial course, while others hold that the secondary symptoms should be awaited to afford convincing proof that the malady is in truth constitutional. No doubt the latter view is correct, for there seems little reason to believe that urgency is ordinarily demanded in such cases, even if they are syphilitic, and it can not be possible, even for the most experienced, to say absolutely and certainly whether a certain ulcer is or is not specific. If, therefore, a non-specific ulcer is treated as a specific one, by the giving of mercury, the diagnosis must for a long time, and perhaps forever, remain in doubt, and thus much injustice may be done, for who shall know that the case is not one of syphilis in which the appearance of later symptoms has been prevented by the treatment? That the larger number of cases of syphilis in the secondary stage require mercury is generally conceded, and in hereditary syphilis the same demand exists. In tertiary syphilis an iodide is generally more employed than mercury, but it can not be doubted that in this stage the addition of mercury to the iodide will often be productive of greater rapidity of cure; and when the tertiary lesion, perhaps a gumma, is so situated that its presence is a menace to a delicate and important part of the body, especially any part of the nervous system, its rapid removal is urgently demanded, and this is effected more surely by the use of mercury with the iodide than by the use of the iodide alone.

In giving mercury for the cure of syphilis it should not be so freely given that salivation may occur, else a new suffering and a great one is added and little or nothing is gained. The limit of physiological activity manifested in such cases should be slight tenderness of the teeth, and to prevent the further manifestations of the remedy upon the mouth it is well to use a mildly cleansing and astringent mouth wash during a mercurial course. The treatment is generally pursued throughout the active manifestations of the disease, with intermissions of a few weeks to promote elimination and to maintain the health of the body and its reaction to the remedy. The treatment

is furthermore usually continued, at intervals, for a year or eighteen months after the disappearance of the last symptom. How the anti-syphilitic action of mercury is to be explained we are quite unaware. The remedy promotes tissue change throughout the body, it increases absorption and augments elimination. Perhaps these are sufficient to explain the curative action of mercury upon syphilis, but other remedies, to a greater or lesser degree, have the same action upon nutrition that mercury has, and yet their efficiency in syphilis is not so great. Whatever the explanation, it is certain that mercury is curative in syphilis.

[In cases in which mercury fails to show its usual remedial action important benefit has been derived from the use of *cantharidin* as an adjunct. At a meeting of the Hufeland Society of Berlin (*Dtsch. Med.-Ztg.*, Jan. 9, 1896) Dr. Liebreich presented a patient in whom was exemplified the stimulating action of cantharidin. The man had *syphilis*, and had been treated with mercury without the least benefit until cantharidin also had been used, when the mercury had exerted its usual curative action and the syphilitic manifestations had subsided. At the time he was shown the man considered himself well and was pronounced cured. At the same meeting Dr. Saalfeld said that he had treated a number of patients with mercury and cantharidin simultaneously. Some of them had manifestly had pulmonary tuberculosis, in which disease, as was well known, great caution was necessary in the use of mercury. In others of them syphilitic ulcers had defied an exclusive treatment with either mercury or iodide of potassium. The speaker had found that he could treat the tuberculous patients with ordinary doses of mercury without any harm resulting, provided he gave them cantharidin at the same time; and in both these groups of patients indolent ulcers that had before shown no tendency to heal had improved under the use of cantharidin.]

There are several methods by which mercury may be introduced within the body and its constitutional effects evoked. It may be given by *inunction*. This is practised usually with the official ointment of mercury, and the method will be presented when the consideration of mercurial ointment is reached. Mercury may be used by *fumigation*. This will be considered when calomel is discussed. It may be given by the rectum, and there are official suppositories of mercury, *suppositoria hydrargyri* (Br. Ph.). The rectal administration, however, is not to be recommended. It is most commonly given *by the mouth*, the preparation varying with the exigencies of the case and the preferences of the prescriber. The more active and irritant preparations are to be given after meals, and in fact it is well to administer all preparations which are designed for systemic effect at this time, that absorption may be more naturally effected. The use of mercurials for hepatic and intestinal effect, however, has no such requirements, and purgatives, as we know, are more active if given during fasting. Finally, mercury may be administered *hypodermically* or by *intravenous injection*. The latter method is objectionable and dangerous, and it is not my purpose to describe it; the former is objectionable, too, as is all prolonged hypodermic treatment, but is certainly less dangerous than intravenous injection. The hypodermic method, however, has the advantage of rapidity of action, and many excellent results have been reported from its use. Several mercurial salts have been recommended for subcutaneous injection, among them the formamide, the albuminate, the peptonate, and the bichloride. The bichloride is the preparation most commonly employed; according to Bartholow, a suitable solution may contain 1 grain of corrosive sublimate and 1 fl. drachm each of glycerin and distilled water. Of this, 10 minims may be injected once a day. Another solution, recommended by Matthês, contains 15 grains of corrosive sublimate, 30 grains of sodium chloride, and 3 oz. of distilled water. Of this, 15 minims are injected every other day. The peptonate may be employed, but is unstable and likely to cause irritation. In all cases the injection should be made deep into the tissues, and the back is the place usually selected for the purpose. Induration of long continuance is a common result of this practice and abscess is not unusual.

Thus far mercury has been dealt with in a general way and those things only have been considered which concerned it and its salts in common. Many deviations from these generalizations must be made with regard to the mercurial salts, because of individual characteristics which they possess, and it is therefore necessary that these combinations and salts of mercury should each be separately considered.

Metallic mercury enters into a number of official preparations. In all these it exists in a state of fine division, and its action is therefore that which has already been described. Mass of mercury, *massa hydrargyri* (U. S. Ph.), mercurial pill, *pilula hydrargyri* (Br. Ph.), blue mass, blue pill, is metallic mercury triturated with several excipients until no mercurial globules are visible, either to the naked eye or by a low-power microscope. The constituents, according to the U. S. Ph., are 33 parts of mercury, 5 of powdered licorice, 25 of powdered althæa, 3 of glycerin, and 34 of honey of rose. According to the Br. Ph., the composition is 2 parts of mercury, 3 parts of confection of roses, and 1 part of powdered licorice root. The dose is from 1 to 15 grains. The remedy is usually given rolled into a pill, and the familiar expression a "blue pill" generally signifies 3 or 5 grains of the mass so treated. Blue mass is an excellent preparation of mercury. It is little irritating and it is adapted to alterative as well as to cathartic uses. For its alterative action, doses of 1 grain may be administered and rather frequently repeated. Larger doses may be employed where haste is necessary, but irritation of the intestines is then apt to occur unless a small amount of opium is combined with the remedy. A dose of from 5 to 15 grains is suitable for a cathartic action, and blue mass is particularly to be recommended in cases where a pronounced effect upon the liver is desired. Like calomel, how-

ever, another cathartic, preferably a saline, should follow it, for otherwise its action is unsatisfactory or incomplete.

Mercury with chalk, *hydrargyrum cum creta* (U. S. Ph., Br. Ph.), gray powder, is also a trituration of mercury, the process being carried on until mercurial globules disappear. According to the U. S. Ph., it is made of 38 parts of mercury, 10 of clarified honey, and 57 of prepared chalk; sufficient water is also employed to aid in the trituration, but this is afterward removed by drying. According to the Br. Ph., it contains 1 oz. of mercury and 2 oz. of prepared chalk. It is a grayish powder which has no odour. The American preparation has a slightly sweetish taste. Both preparations are insoluble in water. The dose of the British preparation is from 3 to 8 grains, but doses of much larger size are allowable, even to ½ a drachm. Eight grains of the American preparation contain about 3 grains of mercury. Mercury with chalk is similar to blue mass in action, but is weaker still. It is a good alterative and particularly serviceable in *intestinal disorders* in which bile production is insufficient. The chalk it contains serves to give the preparation an antacid power, and therefore to render it useful in *diarrhœa.* It may be used as an *antisyphilitic* for children. The dose for a child is from 1 to 2 grains.

Mercurial ointment, *unguentum hydrargyri* (U. S. Ph., Br. Ph.), *unguentum hydrargyri cinereum* (Ger. Ph.), blue ointment, is an incorporation of mercury with a fatty base, the mixture being so intimate that no mercurial globules are observable. The preparation of the U. S. Ph. contains 50 parts of mercury, 25 of lard, 23 of suet, and 2 of oleate of mercury, the last-named ingredient aiding in the easier extinguishment of the metallic mercury. The German preparation contains 10 parts of mercury, 13 of lard, and 7 of suet. The preparation of the Br. Ph. contains 16 parts each of mercury and prepared lard and 1 part of prepared suet. There is also recognised a compound ointment of mercury, *unguentum hydrargyri compositum* (Br. Ph.), which contains 6 parts of ointment of mercury, 3 parts each of yellow wax and olive oil, and 1½ part of camphor. The camphor is thought to promote the absorption of the mercury. Mercurial ointment is usually applied with inunction. It may be used as a resolvent in *local indurations* and *enlargements*, especially those of the *lymph glands*, such as *bubo.* It is oftener employed for its constitutional action in *syphilis*, and may take the place of internal medication when that is ill borne, or may be used in combination with it to accelerate the cure. It is a disagreeable method of treatment, however; accuracy of dose is not possible with it, and salivation is easily produced. The rubbing is usually done once a day, in some cases twice; the amount of ointment employed is from 15 to 30 grains, unless salivation is sought for, and in that case a drachm may be used. The parts of the body into which the ointment is rubbed are those where the integument is least thick, and the inner aspect of the legs, thighs, and arms, the axillæ, the inguinal regions, and the flanks are usually the situations which are chosen. The treatment is generally a prolonged one, and therefore the parts named should be used in rotation, for if one part only is used, irritation and eruption will generally occur there, to the disadvantage of the patient and to the interference with further applications to that part. The rubbing is continued until the ointment is absorbed, and previous washing of the part with soap and water is thought to favour its more rapid absorption.

Mercurial ointment may be used for the treatment of *infantile syphilis*, a piece as large as a hickory nut being spread each day upon the abdominal binder which is usually worn, the binder being unchanged until it becomes stiffened, when a fresh one is substituted. A mixture of equal parts of mercurial ointment and belladonna ointment is useful as a resolvent and anodyne for application to *acute* and *subacute articular inflammations.* A similar application may be useful in *localized* and even in *general peritonitis*, and its efficacy is said to be increased by covering the ointment with a poultice. The danger of absorption from the too generous application is great, rather more, however, from the belladonna than from the mercury. Mercurial ointment may be serviceable to promote absorption in joint diseases with *articular effusion*, and its resolving action in the subacute stage of *orchitis* and *epididymitis* is well known. The addition of camphor to mercurial ointment is recommended by some; "Scott's dressing" consists of 1 oz. of mercurial ointment combined with 1 drachm of camphor. It is doubtful whether it accomplishes anything beyond making the application more irritating. Occasionally mercurial inunction is practised upon blistered surfaces.

Mercurial plaster, *emplastrum hydrargyri* (U. S. Ph., Br. Ph., Ger. Ph.), according to the U. S. Ph., contains 300 parts of mercury triturated with 12 parts of oleate of mercury until the metallic globules disappear, when enough lead plaster is added to make the mixture contain 1,000 parts. The British preparation contains 164 parts of mercury, 7 parts of olive oil, 1 part of sublimed suphur, and 328 parts of lead plaster, compounded, of course, with the usual trituration. The plaster of the Ger. Ph. contains 2 parts of mercury, 1 part of turpentine, 6 parts of lead plaster, and 1 part of yellow wax. Mercurial plaster is applied over *syphilitic nodes* and *glandular* and other *enlargements* for the sake of its resolvent action. It may be useful in *chronic synovitis* by virtue of contributing to resolution, counter-irritation, and mechanical support. It is thought capable of diminishing *enlargement of the spleen* due to *chronic malarial poisoning.* Absorption of mercury in sufficient quantity to cause ptyalism may happen from the use of the plaster; it therefore behooves the medical attendant to watch the condition of the gums and teeth with care. Mercurial plaster has been recommended to prevent the *pitting of small-pox.* It seems efficacious if applied to the pustules early, but not more so than mercurial ointment, and in fact the plaster at the present

time has far less use in all suitable conditions than the ointment.

A preparation of similar utility, which is perhaps more stimulating, because of its other important ingredient, is ammoniac plaster with mercury, ammoniacum and mercury plaster, *emplastrum ammoniaci cum hydrargyro* (U. S. Ph., Br. Ph.). This, according to the Br. Ph., contains 656 parts of ammoniac, 164 parts of mercury, 7 parts of olive oil, and 1 part of sublimed sulphur; and, according to the U. S. Ph., 720 parts of ammoniac, 180 of mercury, 8 of oleate of mercury, and enough lead plaster to make 1,000. Diluted acetic acid to the amount of 1,000 parts is also used in the making, but is afterward dissipated by evaporation. Like mercurial plaster, this preparation is at times applied over *chronically enlarged livers* and *spleens* with the expectation that their diminution will be accomplished.

Liniment of mercury, *linimentum hydrargyri* (Br. Ph.), contains 1 part each of ointment of mercury, solution of ammonia, and liniment of camphor. It is a stimulating and discutient application employed to effect the absorption of *fluid effusions* and of *chronic articular* and *glandular enlargements* and of *various indurations*, especially those which are syphilitic. One drachm is the amount generally applied, and it is to be rubbed upon the diseased part once or twice daily. It should be shaken before being used. Salivation is said to be exceedingly likely from its employment.

Mercurial suppositories, *suppositoria hydrargyri* (Br. Ph.), contain 5 grains of ointment of mercury and 10 grains of oil of theobroma in each. They may be used as substitutes for the internal administration or the inunction of mercury. They are seldom employed.

Mercury Oxides.—The official oxides of mercury are two in number—the yellow and the red. Yellow mercuric oxide, *hydrargyri oxidum flavum* (U. S. Ph., Br. Ph.), *hydrargyrum oxydatum via humida paratum* (Ger. Ph.), is a yellow amorphous powder without odour and of metallic taste. It is insoluble in water, is permanent in the air, and becomes darker upon exposure to light. It differs from the red oxide in being amorphous and more finely divided. It is for this reason that the yellow oxide is so much employed in ophthalmic practice, for the red oxide, no matter how carefully pulverized, will still contain irritating crystalline particles. Ointment of yellow mercuric oxide, *unguentum hydrargyri oxidi flavi* (U. S. Ph.), the preparation in which it is used, contains 10 per cent. of yellow mercuric oxide. This is too strong for most cases, however, and the ointments used in diseases of the eye contain generally not more than 4 grains of the oxide in 1 drachm of any simple and unirritating ointment, such as vaseline, lanolin, or lard. In *acute conjunctivitis* an ointment containing ½ a grain of the oxide to 1 drachm may be useful, but it is in *affections of the lids* that the mercurial salt is especially efficient. In *chronic marginal blepharitis* or *eczema of the lids* an ointment which contains 2 grains to the drachm is useful, but should not be allowed to enter the eye. It is to be applied at bedtime. The ointment may be introduced into the eye in *phlyctænular ophthalmia*, a piece of pin-head size being placed beneath the upper lid; and in *corneal opacities* the ointment may be used in connection with massage. An ointment containing 1 grain to the drachm is thought serviceable in *chronic rhinitis*, and a 2 to 4-per-cent. ointment may be a useful application to small patches of *eczema*.

Red mercuric oxide, *hydrargyri oxidum rubrum* (U. S. Ph., Br. Ph.), *hydrargyrum oxydatum* (Ger. Ph.), red precipitate, has the same chemical formula, HgO, as the yellow oxide. It differs from it in being crystalline. It appears in orange-red crystalline scales or in a crystalline powder which becomes more yellow the finer it is divided. It has no odour, but has a metallic taste. It is permanent in the air and is practically insoluble in water. Like the yellow oxide, the red oxide is rarely given internally, because of its severity of action. It is somewhat employed in ophthalmic practice, but has largely been displaced by the yellow oxide. It may be used as a *stimulant* and *escharotic* application, when finely powdered, in the treatment of *unhealthy ulcerations*. It is ordinarily employed in the ointment of red mercuric oxide, *unguentum hydrargyri oxidi rubri* (U. S. Ph., Br. Ph.), *unguentum hydrargyri rubrum* (Ger. Ph.). This ointment, according to the U. S. Ph., contains 10 parts of finely powdered red mercuric oxide, 5 of castor oil, and 85 of ointment. The British ointment contains 1 part of finely powdered red oxide of mercury, 1¾ part of hard paraffin, and 5¼ parts of soft paraffin. The German ointment contains 10 per cent. of red oxide of mercury in paraffin ointment. The employment of the ointment of red oxide of mercury is in the same class of cases as are treated with the ointment of the yellow oxide, but the latter preparation is in many cases to be preferred because of its being less irritating. The ointment of red oxide is, however, a serviceable and suitable application for *unhealthy ulcerations*, especially those which are *venereal*. Absorption in sufficient quantity to cause ptyalism may follow its use if the area of application is unduly large. The ointment of red oxide of mercury is sometimes used in combination with other remedies for the relief of *parasitic skin diseases*. A combination much employed in *ringworm of the scalp* is:

℞ Ointment of red mercuric oxide 1½ drachm;
Sulphur ointment............. 3 drachms;
Ointment of zinc oxide........ to 1 oz.
Mix. To be rubbed in twice daily.

Oleate of mercury, *oleatum hydrargyri* (U. S. Ph., Br. Ph.), according to the U. S. Ph., is composed of 2 parts of yellow mercuric oxide and 8 of oleic acid. The British preparation is weaker, containing 1 part of yellow oxide of mercury and 9 parts of oleic acid. This preparation resembles mercurial ointment in action, but is more absorbable as well as more irritating. To diminish its irritant action, morphine (not one of its salts) may be combined with it in the proportion of 1 grain

to 1 drachm. Oleate of mercury may be advantageously substituted for blue ointment in the treatment of *syphilis*, but it should not be rubbed in as blue ointment is, or at least not so vigorously, on account of its irritant properties. Thus employed, it has the advantage over blue ointment of being far more cleanly. Oleate of mercury is an excellent application to promote resolution in *inflammatory indurations*, *chronic articular enlargements*, and similar inflammatory conditions of chronic character. It is also useful as an *antiparasitic* in *sycosis* and *tinea tonsurans*, as well as in some varieties of *eczema*.

Mercury Chlorides.—Mercurous chloride, mild mercurous chloride, *hydrargyri chloridum mite* (U. S. Ph.). subchloride of mercury, *hydrargyri subchloridum* (Br. Ph.), mild chloride of mercury, chloride of mercury, *hydrargyrum chloratum* (Ger. Ph.), *hydrargyrum chloratum vapore paratum* (Ger. Ph.), calomel, *calomelas*, is a white impalpable powder without odour or taste. It is insoluble in water and in alcohol. It is permanent in the air. Its formula is Hg_2Cl_2. Calomel is one of the most valuable purgatives we possess, if not the most valuable. It is slow in its action, it is true, and often unreliable as well. It is apt to be retained, and therefore may subject the patient to the possibility of too much mercurial absorption, but all these objections are easily overcome by combining it with another purgative, such as jalap, scammony, or gamboge, or following it in six or seven hours by a saline cathartic. Calomel may cause griping, too, but this is not properly to be attributed to the calomel itself, for it is a very mild and unirritating preparation, but rather to the acrid bile which it causes the liver to disgorge. For the same reason, bilious vomiting may follow the use of calomel, but not because of the drug itself, for calomel is indeed sedative to the gastric mucous membrane, being retained when other remedies would be rejected, and often efficient as an *antemetic* when given in small doses. It is because of its action upon the liver that calomel is so serviceable a cathartic; though blue pill, indeed, acts similarly, it is not so efficient as calomel is. The action of calomel is to cause an increase of biliary discharge from the liver and bile ducts, and therefore its action in purgative doses is of the greatest value in conditions like *jaundice*, *malarial fevers*, and "*biliousness*," where biliary discharge is deficient and where portal congestion exists. Apart from the hepatic activity which follows the use of a single purgative dose of calomel, a similar and even more vigorous action is obtained from the use of small doses frequently repeated, and many prefer to elicit hepatic and intestinal secretion by the administration of from $\frac{1}{4}$- to $\frac{1}{2}$-grain doses every half hour or hour until catharsis occurs or until 2 or 3 grains have been taken. The action of calomel as an intestinal alterative is evoked by the use of doses which are smaller still, and *infantile diarrhœa* is often much benefited by the administration of calomel in doses of from $\frac{1}{20}$ to $\frac{1}{8}$ of a grain every two or three hours; while adults with diarrhœa may take from $\frac{1}{8}$ to $\frac{1}{4}$ of a grain every hour or two. The benefit is soon apparent in an improvement of the character of the movements and a cessation of the nausea, if there has been any. In *functional disturbances of the liver* associated with deficiency in the bile eliminated, from $\frac{1}{2}$ to 1 grain of calomel may be taken with advantage each night or every second night, and followed by a saline cathartic next morning. Purgative doses of calomel are *anthelminthic*, it is said, apart from the action they may have to expel *worms* by virtue of catharsis. For habitual constipation calomel is not a desirable remedy, but for *occasional constipation*, especially in those of "bilious" habit, it may well be employed. The purgative dose of calomel ranges from 5 to 15 grains, but 15 grains is an unusually large dose, and 10 grains is seldom exceeded where purgation is intended. Yet much larger doses are often given as general *sedatives* in the earliest hours of acute febrile and inflammatory diseases such as *pneumonia*, *dysentery*, *cholera*, and *yellow fever*. In fact, many think this procedure able even to abort pneumonia if used sufficiently early in the disease. The doses used thus are often enormous, 20 grains being the smallest, 40 grains common, and 60 grains not rare. Moreover, these doses are often repeated in half an hour or an hour, according to necessity. Curiously enough, no hypercatharsis results from such treatment, for it seems that 15 grains is about as large a dose as can be used effectively as a cathartic. The explanation of this is thought to lie in the fact that calomel given by the mouth is converted into a black oxide of mercury in the intestines, and is dissolved in the alkaline and fatty fluids there present. These fluids can convert and absorb only a limited quantity of calomel, and therefore the rest, so far as catharsis is concerned, remains inactive. This explanation seems to be satisfactory, though it must be confessed that we are not so familiar with intestinal chemistry as might be desired. The theory that calomel is active because it is converted in the stomach into corrosive sublimate is no longer credited, though it is possible that this conversion may sometimes occur and that the occasional untoward action of the remedy may so be explained. Calomel in fractional doses is serviceable as a *diuretic*, but the danger of ptyalism is great.

Calomel may also be employed as an alterative in *constitutional syphilis*. For this purpose from $\frac{1}{8}$ to $\frac{1}{4}$ of a grain may be given three times a day. If rapid action and salivation are desired, the frequency of administration should be greater; but, as the treatment is generally prolonged, it often becomes necessary in such cases to combine a small amount of opium with each dose, else undesirable intestinal activity may ensue. The constitutional effects of mercury may be evoked by *calomel fumigation*. This is performed by placing the naked patient in a chair and surrounding him from the neck down, as well as the chair, with a blanket. Beneath the chair is placed a spirit lamp, over which is situated a small dish to contain the calomel and resting in another

dish containing water. One dish alone may be employed if necessary, and in that case the calomel is simply placed in it together with about 2 oz. of water. The patient being seated, the lamp is lighted, and the fumes of calomel rising, together with watery vapour, are deposited upon the surface of the patient and are readily absorbed. The duration of the fumigation should be about fifteen minutes. It may be used once or twice a week. The amount of calomel employed is usually between 10 and 20 grains. Other mercurial preparations may be substituted for the calomel, but are by no means so desirable. Following the fumigation the patient is at once wrapped in the blanket and placed in bed. The procedure is of particular service when the internal employment of mercury is interdicted.

[Dr. H. W. Berg, of the Willard Parker Hospital (*Med. Record*, Jan. 12, 1895), speaks favourably of the action of calomel fumigations in the treatment of *diphtheria* and *croup*. The calomel, he remarks, should be volatilized under a tent formed by cloths arranged over a frame so as to inclose the bed. He thinks the mercurial thus employed may have some local effect as a germicide, but that to its rapid absorption and its constitutional action most of its efficiency in lessening the swelling of the mucous membrane and softening the false membrane and hastening its detachment is to be ascribed.]

Calomel powdered finely may be used as a dusting powder for *venereal ulcerations* and *herpetic eruptions*. Thus used, it is *desiccant*, *alterative*, and *stimulant*. An ointment containing from 1 to 4 per cent. of calomel may be useful if applied to *eczema* of the chronic type. In acute eczema it is too stimulating. In *otorrhœa* calomel may be insufflated with advantage, the parts having previously been cleansed with solution of corrosive sublimate. Similar insufflations are serviceable in *syphilitic laryngitis* and *diphtheria*. It may be dusted upon the eye in *phlyctænular ophthalmia*, but should not be used when much ciliary irritation exists. Insufflations of bismuth subnitrate or powdered sugar containing about 5 grains of calomel to 1 oz. may be used with benefit in *chronic nasal inflammation*, especially if it is specific.

Among the official preparations containing calomel are compound cathartic pills, *pilulæ catharticæ compositæ* (U. S. Ph. [see CATHARTICS]). Compound pills of antimony, *pilulæ antimonii compositæ* (U. S. Ph.), compound pill of subchloride of mercury, *pilula hydrargyri subchloridi composita* (Br. Ph.), *pilula calomelanos composita*, Plummer's pills, contain 1 part each of calomel and sulphurated antimony, 2 parts of guaiacum resin, and a sufficiency of castor oil. The dose is from 5 to 10 grains. This pill is used in *chronic rheumatic* or *gouty conditions* and in *chronic skin diseases*, especially if *syphilitic*. (See ANTIMONY.)

Ointment of subchloride of mercury, *unguentum hydrargyri subchloridi* (Br. Ph.), contains 1 part of calomel and $5\frac{1}{2}$ parts of benzoated lard. It may be used in *skin diseases*, but is unnecessarily strong. Black wash, black mercurial lotion, *lotio hydrargyri nigra* (Br. Ph.), contains 1 part of calomel and 146 parts of solution of lime. As ordinarily prepared in the United States, black wash contains 1 drachm of calomel and 1 pint of lime-water, black oxide of mercury being formed by their mixture. It is much used as a dressing for *venereal ulcerations* in their inflammatory stage or following their cauterization. It is applied on gauze and replenished frequently. It is occasionally applied to *eczematous patches*. The mixture should be shaken previous to being applied.

Mercuric chloride, corrosive mercuric chloride, *hydrargyri chloridum corrosivum* (U. S. Ph.), corrosive sublimate, perchloride of mercury, *hydrargyri perchloridum* (Br. Ph.), bichloride of mercury, *hydrargyrum bichloratum* (Ger. Ph.), occurs in colourless crystals or crystalline masses. It has no odour, but an acrid, persistent, and metallic taste. It is permanent in the air and soluble at 59° F. in 16 parts of water and in 3 parts of alcohol. Its formula is $HgCl_2$.

Corrosive sublimate, when given in doses of between $\frac{1}{100}$ and $\frac{1}{50}$ of a grain, not oftener than three times a day, is a systemic *tonic* of much value, the corpuscular richness of the blood as well as the general nutrition improving under its use without further indication of its presence. Doses somewhat larger act similarly, but the cutaneous, renal, and intestinal secretions are then apt to become increased and diarrhœa may occur. This diarrhœa may be prevented by combining a little opium with the corrosive sublimate. Bichloride of mercury is less apt to cause salivation than calomel is. In doses unduly large corrosive sublimate causes burning pain in the stomach, cramps, nausea, vomiting, and diarrhœa. In poisonous doses it causes violent gastro-enteritis and death. The symptoms observed in cases of poisoning by it are intense pain in the œsophagus, stomach, and intestines, nausea, vomiting, thirst, and diarrhœa. The vomitus often contains blood, and so do the stools occasionally. Great anxiety and restlessness are present, with a rapid and feeble pulse, a cold, clammy skin, prostration, severe cramplike pains in the extremities, and finally collapse and death. Convulsions occasionally precede death. If the patient survives for a sufficient time, salivation may be observed. This acute poisoning by corrosive sublimate is generally the result of its internal administration in poisonous amount, but cases have been reported where children have manifested the symptoms described after too extensive an application of the drug externally. The antidote is egg albumin, and therefore white of egg should be administered as promptly as possible, a comparatively insoluble albuminate of mercury being formed. As the insolubility of this combination, however, is not absolute, the stomach should be evacuated promptly and thoroughly cleansed, preferably with the stomach-tube. If egg albumin can not be obtained promptly, wheat flour or milk may be substituted for it. Further than these meas-

ures, stimulants and sedatives are usually required, and the subsequent treatment is that of gastro-enteritis. The poisoning which may follow the medicinal use of mercuric chloride, and is characterized by ptyalism, does not differ from the ordinary mercurialization which has been described, save in the greater prominence of diarrhœa.

Corrosive sublimate is much given for its *antisyphilitic* action, either alone or in combination with sodium or potassium iodide in the well-known "mixed treatment." The antisyphilitic doses of corrosive sublimate generally employed range between $\frac{1}{32}$ and $\frac{1}{8}$ of a grain. It may be given carefully incorporated with bread crumb in pill, but preferably in solution. The remedy should be given after eating. Corrosive sublimate is also employed as an alterative in *chronic rheumatic* and *gouty affections*, in some forms of *chronic skin disease* which are not necessarily syphilitic in their causation, and to promote the absorption of *small exudations* in their chronic stage. The doses suitable for these purposes are the same as those employed in syphilis. The remedy is often combined with other alterative drugs, notably iodides, antimony, and arsenic. As an *internal antiseptic* bichloride of mercury may occasionally be useful in *gastric fermentation;* but its employment to check intestinal putrefaction is neither reasonable nor effective, for any dose which may safely be administered will doubtless be absorbed before the small intestine is reached, and intestinal disinfection is not likely to be accomplished by the small dose it is safe to give even if the entire amount passed unchanged through the intestine. Corrosive sublimate in alterative doses is efficient in some cases of *deficient secretion of bile*, for, as I have already said, the remedy is undoubtedly an active cholagogue. By some, mercuric chloride in doses of $\frac{1}{100}$ of a grain, frequently repeated, is highly esteemed in *diphtheria.*

The external employment of corrosive sublimate is exceedingly important. In full strength it is *caustic* and *disinfectant.* Its dilute solutions are *antiseptic.* The use of corrosive sublimate as a caustic is not free from danger, absorption sufficient to cause poisoning having occurred from it. Nevertheless, it has been employed in *malignant pustule* with success, and *onychia maligna* is said to be much benefited by an application of powdered mercuric chloride and zinc sulphate, in equal parts by weight. The powder is sprinkled over the ulcer and covered with gauze wet in tincture of myrrh. Destruction of the unhealthy ulcer and healing are said to follow. In *lentigo* a solution of mercuric chloride containing from 2 to 4 grains to 1 oz. of alcohol, painted on repeatedly, is said to cause exfoliation and cure. A solution in collodion which contains from 2 to 4 per cent. of corrosive sublimate is often employed for the removal of *nævi* and *telangeiectases*, acting as a slow caustic and being productive of vascular obliteration and healing. The application may be made every day for several days, but the practice is certainly not free from danger. As *antiparasitics*, solutions of corrosive sublimate are often employed. Thus, a 1-to-500 solution in vinegar is recommended in *phtheiriasis pubis* and *phtheiriasis capitis*, the ova being destroyed by it as well as the mature parasites. In *tinea circinata* and *tinea versicolor* a solution containing from 2 to 4 grains to 1 oz. of compound tincture of benzoin is said to be efficient if painted on once or twice daily. *Ringworm of the scalp* is said to be benefited by the employment of an alcoholic solution of the same strength, painted on. *Lupus vulgaris* is much modified by the application of an ointment containing from 2 to 8 per cent. of corrosive sublimate, but in all these external uses of corrosive sublimate, where the strength of the preparation is great or where the area of application is more than minute, the greatest care and closest observation are required lest dangerous absorption occur.

The surgical employment of solutions of bichloride of mercury is, of course, the most important use of the drug externally, but this is a subject which is more fully considered elsewhere. (See ANTISEPTICS.) Suffice it to say here that the surgical affections in which "bichloride" solutions are not employed are the rare exceptions, and for operative antisepsis these solutions are more used than any others. The strengths of solutions appropriate for the various purposes are as follows: For *disinfecting the skin*, especially the hands of the operator, 1 in 1,000; for washing out *small wounds*, 1 in 2,000; for washing out *larger wounds* and cavities, 1 in 5,000 to 1 in 10,000; for *irrigating the vagina*, 1 in 5,000 to 1 in 10,000; for *irrigating the urethra*, 1 in 20,000 to 1 in 40,000; for *use on the conjunctiva*, 1 in 5,000; for *gargling*, 1 in 5,000 to 1 in 10,000. The germicidal action of all these is far greater if they are used hot, and they may therefore be heated to as high a point as can comfortably be borne. Yet the too generous application even of these solutions is to be avoided, else dangerous absorption may follow. Absorption, too, is especially rapid from serous membranes, and therefore mercury bichloride solutions should not be used upon them. The solutions should invariably be made fresh, for, if they are allowed to stand exposed, the bichloride in solution is slowly converted into the protochloride. For convenience in making these solutions, tablets are prepared and much employed which usually contain 7·7 grains of corrosive sublimate and 7·3 grains of ammonium chloride, the latter salt being added to make the tablet more soluble. One of these tablets dissolved in a pint of water makes a 1-to-1,000 solution of corrosive sublimate.

Solution of perchloride of mercury, *liquor hydrargyri perchloridi* (Br. Ph.), contains 1 part each of perchloride of mercury and chloride of ammonium and 875 parts of distilled water. It is a convenient means of administering mercuric chloride. The dose is from $\frac{1}{2}$ to 2 fl. drachms.

Yellow mercurial lotion, *lotio hydrargyri flava* (Br. Ph.), yellow wash, *aqua phagedænica*, contains 1 part of perchloride of mercury and 243 parts of solution of lime. As extemporane-

ously prepared in the United States, it is usually composed of ½ a drachm of corrosive sublimate and 1 pint of limewater. Yellow oxide of mercury is formed by the combination. Yellow wash is similar to black wash in its action, but is more stimulating and is less often employed. Its chief employment is as a dressing for *phagedænic chancroids*.

Ammoniated mercury, *hydrargyrum ammoniatum* (U. S. Ph., Br. Ph.), *hydrargyrum præcipitatum album* (Ger. Ph.), mercuric ammonium chloride, chloride of mercuric ammonium, white precipitate, is a white amorphous powder without odour, but of an earthy taste and a metallic after-taste. It is insoluble in water and in alcohol. It is permanent in the air. It is a precipitate formed by the action of ammonia water upon a solution of mercuric chloride. Its formula is NH_2HgCl. It is a highly poisonous salt, its toxic symptomatology being similar to that of corrosive sublimate. The treatment in poisoning is the same as that for poisoning by corrosive sublimate. Ammoniated mercury is used for external application only, in the form of ointment. Ointment of ammoniated mercury, *unguentum hydrargyri ammoniati* (U. S. Ph., Br. Ph.), *unguentum hydrargyri album* (Ger. Ph.), ointment of white precipitate, is a 10-per-cent. preparation. These official ointments are too strong; they are local irritants and are apt to cause ptyalism by absorption. The strength of an ointment proper to be used varies between 1 and 4 per cent. If it is of this strength it is an efficient application for *tinea tonsurans*, *tinea circinata*, *chronic eczema*, *psoriasis*, and *scaly syphilitic eruptions*. In psoriasis of the head and face this ointment is advantageous because it does not discolour the skin.

Mercury Iodides.—The official iodides of mercury are two, the red iodide and the yellow iodide. Red mercuric iodide, red iodide of mercury, *hydrargyri iodidum rubrum* (U. S. Ph., Br. Ph.), *hydrargyrum bijodatum* (Ger. Ph.), biniodide of mercury, is a scarlet amorphous powder without odour or taste. It is almost insoluble in water, slightly soluble in alcohol, and permanent in the air. Its formula is HgI_2. Biniodide of mercury is locally an irritant. In overdose it causes the same toxic symptoms as are due to corrosive sublimate. It is much employed in *late syphilis*, especially for the removal of old deposits, thickenings, etc. It is scarcely more active than corrosive sublimate, though better borne, perhaps. The dose is from $\frac{1}{32}$ to $\frac{1}{8}$ of a grain. The beginning dose should not exceed $\frac{1}{16}$ of a grain, and this may be cautiously increased. It is given in pill. It should not be confounded with the *yellow mercurous iodide*, than which it is far more potent.

Solution of arsenic and mercuric iodide, *liquor arseni et hydrargyri iodidi* (U. S. Ph.), *liquor arsenii et hydrargyri iodidi* (Br. Ph.), Donovan's solution, is a solution containing 1 per cent. each of arsenic iodide and red mercuric iodide in distilled water. It is a valuable *alterative* which is especially useful in *chronic skin diseases*, like *psoriasis*, *lepra*, *lupus*, and *venereal eruptions*. It is efficient in *late syphilis* and in some cases of *chronic rheumatism* and *chronic gout*. The dose is from 5 to 10 drops, given freely diluted. It is incompatible with laudanum and the soluble morphine salts.

Ointment of red iodide of mercury, *unguentum hydrargyri iodidi rubri* (Br. Ph.), contains 1 part of finely powdered red iodide of mercury and 27¼ parts of simple ointment. It is used as a dressing to *indolent ulcers*, especially those which are *syphilitic*.

Yellow mercurous iodide, yellow iodide of mercury, green iodide of mercury, protiodide of mercury, *hydrargyri iodidum flavum* (U. S. Ph.), is a yellow amorphous powder without odour or taste. It is decomposed by light into metallic mercury and mercuric iodide. It is insoluble in alcohol and almost insoluble in water. Its formula is Hg_2I_2. Yellow mercurous iodide, like mercuric iodide, is employed in *late syphilis*. It must not be combined with potassium iodide, for then it is converted at once into mercuric iodide and metallic mercury. The dose is ¼ of a grain.

Mercury Cyanides.—Mercuric cyanide, *hydrargyri cyanidum* (U. S. Ph.), *hydrargyrum cyanatum* (Ger. Ph.), occurs in colourless or white crystals which are without odour, but of a bitter, metallic taste. It is soluble in water and in alcohol. Its formula is $Hg(CN)_2$. It is used medicinally as a substitute for corrosive sublimate for internal administration in *syphilis* and occasionally for antiseptic effect by local application in solution. The dose is from $\frac{1}{16}$ to $\frac{1}{8}$ of a grain. For external antisepsis a 1-in-10,000 solution is said to be efficient. The drug is exceedingly poisonous.

[Oxycyanide of mercury is said by Monod and Magaigne (*Progr. méd.*, Oct. 26, 1895; *Brit. Med. Jour.*, Epitome, Dec. 28, 1895), to show, in a 5-to-1,000 solution, in laboratory experiments an *antiseptic* potency always equal to, and often greater than, that of a 1-in-1,000 sublimate solution. It has no disadvantages other than those possessed by corrosive sublimate, and it has the special advantage of not affecting either the hands or the instruments of the surgeon. It may therefore replace sublimate in surgical practice. This conclusion is based on an experience of the use of the oxycyanide in hospital and in private practice of more than four years, and on laboratory experiments in which the power of the oxycyanide to prevent the growth of cultures, to kill a developed culture, and to sterilize contaminated substances has been tested and compared with that of sublimate. The experiments were made not on pure cultures of streptococci and staphylococci destitute of spores, but on dust from hospital wards containing *Bacillus pyocyaneus*, *Bacterium coli*, streptococci, and especially a bacillus resembling that of anthrax, with spores which resist a temperature of 100° C. No serious toxic effect was ever observed. The authors, however, recommend that the oxycyanide should not be used for washing out cavities, especially where there is danger of any of the fluid being left behind.]

Mercury Nitrate.—Mercuric nitrate, or pernitrate of mercury, is itself rarely used, and is not official save in its solution, *liquor hy-*

drargyri nitratis (U. S. Ph.), acid solution of nitrate of mercury, *liquor hydrargyri nitratis acidus* (Br. Ph.). This solution, according to the U. S. Ph., contains about 60 per cent. of mercuric nitrate, $Hg(NO_3)_2$, with about 11 per cent. of free nitric acid. The solution of the Br. Ph. is composed of 4 oz. of mercury, 5 fl. oz. of nitric acid, and 1½ oz. of distilled water. The solution of mercuric nitrate is considerably used as a caustic. *Syphilitic* and *phagedænic ulcerations* may thus be destroyed, and *noma*, *lupus*, *epithelioma*, and *ulcers of the cervix uteri* as well. The special value of the application is in the prompt destruction of rapidly advancing ulcerations. Small benign growths are sometimes thus removed, especially *moles* and *nævi*. The use of this solution for cauterizing is not free from danger, for sufficient mercurial absorption to cause salivation has followed its use. In case the area of application is more than minute, it should be washed at once after cauterizing, so as to remove any of the solution which otherwise may remain and be absorbed.

Ointment of mercuric nitrate, *unguentum hydrargyri nitratis* (U. S. Ph., Br. Ph.), ointment of nitrate of mercury, citrine ointment, according to the U. S. Ph., is composed of 70 parts of mercury, 175 of nitric acid, and 760 of lard oil; according to the Br. Ph., it is composed of 1 part of mercury, 3 parts of nitric acid, 3⅘ parts of prepared lard, and 8 parts of olive oil. It is a *stimulant* and *alterative*, but is too strong for use save in conditions which require an unusual amount of local stimulation. For ordinary use the diluted ointment of nitrate of mercury, *unguentum hydrargyri nitratis dilutum* (Br. Ph.), is preferable. This contains 1 part of nitrate of mercury ointment and 2 parts of soft paraffin. Citrine ointment is less used than formerly, but if diluted may well be employed in *chronic ulcerative conditions* of any variety. It is serviceable, too, in *chronic eczema*, *psoriasis*, and other chronic and localized cutaneous affections. It should be freshly prepared, for it decomposes with age. Salivation may follow its too generous application.

Mercury Sulphates.—Persulphate of mercury, mercuric sulphate, *hydrargyri persulphas* (Br. Ph.), is a white crystalline powder. Its formula is $HgSO_4$. It is not used in medicine, but is considerably employed in pharmacy.

Yellow mercuric subsulphate, *hydrargyri subsulphas flavus* (U. S. Ph.), basic mercuric sulphate, turpeth mineral, is a heavy, yellow powder, without odour and with little taste. It is slightly soluble in water and insoluble in alcohol. It is permanent in the air. Its formula is $Hg(HgO)_2SO_4$. Though occasionally given as an *alterative*, in doses of from ¼ to ½ of a grain, it is chiefly useful as an *emetic*. Its emetic action is usually prompt and certain. Occasionally it causes salivation. In some few cases it has been retained, and then violent purging and symptoms resembling those of corrosive-sublimate poisoning have been observed. Its emetic action has been thought particularly beneficial in *croup*. The emetic dose for an adult is from 2 to 5 grains; that for a child two years old is from 2 to 3 grains. It should be repeated in 15 minutes if necessary.

[Several other compounds of mercury have been proposed for medicinal use, and some of them tried to a certain extent, but the reports concerning the results of their employment do not appear sufficient to call for consideration of them in this work.]—Henry A. Griffin.

METALDEHYDE, $(C_2H_4O)_6$, a polymer of aldehyde, is a crystalline substance insoluble in water. It has been very little employed in medicine. Dr. Cerna states that it has *hypnotic* virtues very similar to those of paraldehyde and may be given in about the same doses.

METHACETIN, a homologue of phenacetin, is a reddish crystalline powder, $C_6H_4 \left\{ \begin{array}{l} OCH_3 \\ NH.C_2H_3O \end{array} \right.$, readily soluble in water. It is a powerful *antiseptic*, also an *antipyretic* and *analgetic* resembling antipyrine in its action. Large doses are decidedly poisonous, and the drug should be used only with great caution. Ordinarily, not more than 2 grains should be given in a day, and the daily amount of 4½ grains must not be exceeded.

METHOXYCAFFEINE. — This is a methyl-and-oxygen substitution compound of caffeine. Little use of it has been made in medicine. Besides its *anodyne* action in *migraine* and *neuralgias*, it is said, according to Dr. Cerna, to act powerfully as a *local anæsthetic* when injected subcutaneously. He gives the dose as about 4 grains.

METHYL. — [For the medicinal compounds of methyl that are not treated of in this article, see articles on the individual compounds.]

Methyl alcohol, or *methylic alcohol*, is obtained in the destructive distillation of wood, and is variously known as wood alcohol, wood naphtha, or wood spirit and pyroligneous spirit. Its medicinal properties are not very decidedly different from those of ethyl alcohol, and it is rarely employed. In the arts and in many pharmaceutical processes it is largely substituted for the more expensive ethyl alcohol, and is entirely appropriate when it is not permanently combined with articles for internal use. Its vapour is, however, extremely irritating to the air-passages, and the least whiff of it will in many persons excite coughing. It also may give rise to headache and mild symptoms of intoxication in those exposed to it, as in various manufactories where it is used.

Methyl chloride has been used to some extent, in the form of a spray, to produce *local anæsthesia*, but its extreme volatility renders it somewhat difficult to manage, and rhigolene, etc., are preferable.

Methyl ether has been suggested as a substitute for chloroform or sulphuric ether as an *anæsthetic*, but, although it is said to be safe and rapid in its action, it has not been used to any considerable extent.

Methyl Iodide.—This is a heavy liquid which has been used to some extent as a *vesicant*, a few drops being placed upon cotton or lint which is applied, and covered with a watch glass or some similar object. Vesication occurs in a few minutes, with the formation of a bleb very similar to that produced by cantharides. The pain it creates is considerable, and beyond the case of its application and its cleanliness there is little to recommend it.

Methyl Nitrate.—See under NITRIC ACID, in the section in brackets.

Methyl salicylate, *methyl salicylas* (U. S. Ph.), or artificial oil of wintergreen, is a synthetical product obtained by the distillation of salicylic acid or its salts and methyl alcohol in the presence of sulphuric acid. Therapeutically, it differs in no way from the oil derived from the wintergreen plant. (See GAULTHERIA.)

Methyl Violet.—See under PYOCTANINE.

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METHYLACETANILIDE.—See EXALGINE.

METHYLAL, methylenedimethyl ether, $CH_2(OCH_3)_2$, is the product of the interaction of manganese dioxide, sulphuric acid, and methyl-alcohol, purified by fractional distillation and dehydration. It is a colourless liquid of a penetrating ethereal odour.

In 1886 Personali (*Giorn. del. real Acad. di med. di Torino*, 1886, quoted by A. Maisch, *Progr. méd.*, 1887), published a memoir on the physiological action of methylal administered to animals subcutaneously, by the mouth, or by inhalation, in which he stated that it produced a rapid *hypnotic* effect. There were profound sleep, decreased reflex action, lessened frequency but increased amplitude of respiratory action, increased frequency of the heart's action, lowered blood-pressure, diminution of temperature, and lessened activity in metabolism. Mairet and Combemale found that the hypodermic administration of methylal was very painful, and that if the drug was pure there was subsequent ulceration; they found that reflex activity was slow, the pupils were dilated, and after the sleep there was muscular paresis for some hours. Other investigations have shown that it diminishes the irritability of the brain, stimulates the cardiac accelerator and respiratory centres, and first stimulates then inhibits the vaso-motor centre. In large doses it produces various toxic symptoms and irritant lesions that end fatally.

In man doses of from 15 to 120 grains have not caused gastric intolerance, though the physiological effects have not always been identical, and tolerance of the remedy has been produced in from three to eight days. Discontinuing the use of the drug temporarily suffices to re-establish susceptibility.

It is a *hypnotic*, *anæsthetic*, and *antineuralgic*.

It has proved useful in *insomnia* due to simple mania, general paresis, and mental excitement. It has been recommended for *tetany* and for the symptoms due to the prolonged administration of strychnine. Inhalations of methylal are said to relieve *asthma* and *angina pectoris*. Locally, it may be used to relieve *neuralgia*, and is applied in a liniment or ointment containing 15 per cent. of methylal. The dose is from 15 to 120 grains, in solution, at bedtime.—SAMUEL T. ARMSTRONG.

METHYLENE BLUE, tetramethylthionine chloride, $C_{16}H_{18}N_3SCl$, is a diphenylamine compound which is produced by the action of hydrogen sulphide and ferric chloride on an acid solution of dimethylparaphenylenediamine, $NH_2C_6H_4N(CH_3)_2$. It occurs in a fine powder that has, in mass, the colour and appearance of iron filings, but, if a thin layer of the substance is examined or it is brushed over a surface, a blue colour is produced. In solution it produces a bright blue colour, identical with that of a solution of methyl blue, $C_{37}H_{26}N_3S_3O_9Na_3$, the sodium salt of triphenylpararosaniline-trisulphonic acid, with which it is often confounded. Passed Assistant Surgeon A. C. Smith, of the United States Marine-Hospital Service, once called the writer's attention to the fact that the meniscus on the surface of a solution of methylene blue in a test-tube, or a thin film of such a solution, had a greenish instead of blue colour, while that of methyl blue was blue under all circumstances. Another test may be made by adding sodium hydroxide to the blue solution, when methyl blue becomes of a purplish-red resembling port-wine dregs, while methylene blue turns to a deep violet colour.

Combemale and François (*Compt. rend. hebd. des séances et mém. de la Soc. de biol.*, 1890) administered methylene blue to dogs in doses of from 3 to 6 grains to each kilogramme of the animal's weight, and it produced vomiting, diarrhœa, and marked decrease in the daily excretion of urine. These observers found that the smallest fatal dose in the case of guinea-pigs was 4½ grains to the kilogramme of weight; this caused muscular paresis, rapid respiration, and collapse, and the necropsy showed blue colouring matter in the kidneys, lungs, heart, cerebral cortex, and central ganglia of the brain. They specify that there was no discoloration of the axis-cylinder in the sciatic nerve or the nerves of the brachial plexus. Subsequently Combemale (*ibid.*, 1891) held that the drug produced a condition that he called methæmoglobinization, caused by the destructive action of methylene blue on the red blood-corpuscles, and the analgetic effect that had been reported as consequent upon the therapeutic use of the drug he believed was the result of tissue asphyxia following the transformation of oxyhæmoglobin into methæmoglobin.

Methylene blue has been used as a stain for the axis-cylinder of nerves, and P. Ehrlich conceived the idea that it might be administered to living animals to relieve *neuralgias*. In association with A. Leppmann, he published a paper (*Dtsch. med. Woch.*, 1890) in which he called attention to the analgetic properties of methylene blue, administered by the stomach or hypodermically, in *sciatica*, *rheumatism*, *arthritis*, and *synovitis*. Combemale and Fran-

çois (*loc. cit.*) found that it was useful in *intercostal, facial,* and *lombo-abdominal neuralgias.* L. Galliard (*Bull. et mém. de la Soc. méd. des hôp. de Paris,* 1891) and Piotrowski, whom he quoted, reported that it was not a harmless drug; in doses of from ½ to 3 grains it caused malaise, cephalalgia, nausea, and occasionally an ephemeral albuminuria; in doses of from 6 to 10 grains it caused vomiting, diarrhœa, and vesical tenesmus; seven patients had not been benefited, and four had been helped by its administration. As the results of these observers have not been confirmed by the experience of other physicians, it is believed that they used an impure preparation of the drug, or perhaps *methyl blue.* Desnos used methylene blue for the pains of *posterior spinal sclerosis.* C. Paul thought it a useful and harmless *placebo,* in small doses, for neurotic patients, when the physician desired to practise an expectant treatment; and that it could be used with other drugs in lunatic asylums and jails when the physician desired to assure himself that medicine was taken, for in both these instances the green or greenish-blue discoloration of the urine would give the desired information.

P. Guttmann and P. Ehrlich (*Berl. klin. Woch.,* 1891) reported that in consequence of the fact that methylene blue stained the *Hæmatozoon malariæ,* not only in dried specimens but in fresh blood, they had been induced to administer it in the treatment of *paludal fevers.* They, Thayer (*Bull. of the Johns Hopkins Hosp.,* 1892), Mya (*Sperimentale,* 1891), C. Ferreira (*Bull. gén. de thérap.,* 1893), and others found that, while it had no advantages over quinine, yet it exercised a remedial action in malarial fevers in consequence of its toxic effect on the specific organism, though the latter might become tolerant of the drug and the symptoms (chill, fever, etc.) would recur. More recently this drug has been recommended in those forms of paludism in which quinine fails. If it is associated with from 5 to 20 grains of powdered nutmeg any unpleasant secondary effects are unlikely to occur. S. Parewski and S. Blatteis advise that it be administered hypodermically in doses of from ¾ to 1¾ grain daily. They state that the semi-lunar hæmatozoon is most resistant to this drug.

Passed Assistant Surgeon A. C. Smith, of the United States Marine-Hospital Service, administered the drug to two patients affected with *malarial hæmaturia,* with distinct advantage in causing a cessation of the albuminuria and putting an end to the *hæmocytolysis.*

G. Leventhal reports that he has used this drug successfully in the treatment of *acute nephritis,* in doses of 5 grains three times a day, every other day. Dr. Austin Flint has reported a case of *chyluria* due to *Filaria sanguinis hominis* (*N. Y. Med. Jour.,* June 15, 1895) that was cured by two grains of methylene blue every four hours during the day; and that gentleman reported that the drug was useful for *malarial enlargement of the spleen, chronic cystitis,* and *gonorrhœa.*

U. W. E. Thur (Schmidt's *Jahrb.,* 1893) reports that he has given this drug to eleven patients affected with *beri-beri,* and that it caused rapid amelioration in the general condition, quieter and deeper respiration, diminished frequency of the pulse, increased excretion of urine, and diminished anasarca. Althen recommends its administration in the treatment of *tuberculosis.*

Locally, methylene blue may be applied in solution in the treatment of *gonorrhœa, elytritis, suppurating cavities* (such as that of *empyema*), *noma, epithelioma,* and *chronic cutaneous ulcers.*

The writer would suggest, on account of its partial excretion by the fæces, that it may be of use in the treatment of *amœbic dysentery.*

The dose is from ¼ to 2 grains, three or four times a day.—SAMUEL T. ARMSTRONG.

METHYLPYROCATECHIN.—See GUAIACOL.

MEZEREON, MEZEREUM (U. S. Ph.), *mezerei cortex* (Br. Ph.), is the bark of *Daphne Mezereum, Daphne Gnidium,* or spurge-flax, and *Daphne laureola,* shrubs widely distributed through the temperate portions of the eastern hemisphere. It is a violent gastro-intestinal irritant when taken in large doses, and was formerly used as a *cathartic, emetic,* and *emmenagogue* and in the treatment of *rheumatism,* various *cutaneous disorders,* and *syphilis,* but has fallen almost entirely into disuse on account of its harsh and violent action. It still forms, however, one of the constituents of the compound decoction of sarsaparilla. Externally, the fresh or moistened drug is a powerful *rubefacient,* and if its application is too prolonged it causes vesication, which is often followed by ulcers difficult to heal. Its action upon mucous membranes is still more violent, and the dust which arises when it is being powdered gives rise to great irritation of the conjunctiva and air-passages. When vesication is sought for, the fresh bark or that which has been soaked in water or vinegar is applied directly to the skin and maintained in place by a bandage, etc. The irritation produced by cantharides may be prolonged by the use of an ointment containing mezereum, and when the constitutional effects of the cantharides are feared mezereum may be substituted. The fluid extract, *extractum mezerei fluidum* (U. S. Ph.), and the ethereal extract, *extractum mezerei æthereum* (Br. Ph.), are used in the preparation of the compound mustard liniments of the respective pharmacopœias. The Fr. Cod. orders an extract which is the active ingredient of the *pommade épispastique au garou.*

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MICA PANIS (Br. Ph.), bread crumb, the soft part of bread made with wheaten flour, is an ingredient of the charcoal poultice, *cataplasma carbonis* (Br. Ph.); it is sometimes employed as the basis of a pill mass, and occasionally pills consisting of bread crumb alone, bread pills, are given as placeboes.

MICROCIDINE.—This fanciful name has been given to a mixture of β-naphthol and caustic soda, described as an inodorous, cheap, and convenient ashy-coloured powder, soluble in water in the proportion of one to three, and

soluble in alcohol, but insoluble in chloroform. By its physical, chemical, and physiological properties and by its alkaline reaction, microcidine neutralizes the irritating products of acid decomposition. Cozzolino (*Ann. des mal. de l'oreille et du larynx*, Nov., 1893) recommends its employment in *suppurative processes in the ear*. He says its *antiseptic* properties rank it next to corrosive sublimate, and that by its application suppurative discharges are checked in three or four days, even when the drug is used in strengths of 3 or 4 per cent. It is said not to irritate the tissues.

MIGRAININ, MIGRÄNIN. — Dr. M. Overlach (*Dtsch. med. Woch.*, Nov. 23, 1893) has given the name of *Migränin* to a compound which he regards as a citrate of antipyrine and caffeine. He reports that it is an efficient *antipyretic* and *analgetic*, that it is very beneficial in the *headache of influenza*, that due to alcoholic indulgence, and that of morphine poisoning, and particularly that it is of great service in *migraine*, of which it is said not only to cut short the attacks, but also to lessen their frequency. The amount to be given in twenty-four hours is about 17 grains, which may be increased to 40 grains.

MILK.—(For the adulteration of milk, see the succeeding article.) Milk, *lac* (Br. Ph.), being the only product of Nature designed primarily as a food, is the most perfect food known. Being intended for the young of each species, it is not a suitable food for the exclusive use of the adult. Although the milk of various animals is employed by man as food, that of the cow is so universally used to the exclusion of that of other animals that it alone is considered in the present section, except when otherwise mentioned. The composition of milk varies greatly according to the species, the individual animal, the time of milking, and the portion of the milk which is taken for examination. All chemists in recent years have reached approximately the same results, but each differs from the others in his exact figures. Analyses dating back ten years or more are not now considered reliable. In the accompanying table column I represents the variations which may take place in normal milk. Column II is the average cow's milk as given by Leeds in his last work. Column III is that given by König. Column IV is that given by Rotch, based upon examinations made by Harrington. They are the proportions most commonly accepted at the present time:

	I.	II.	III.	IV.
Proteids	3 to 6	3·75	3·76	4·00
Fats	3 to 6	3·75	3·66	4·00
Lactose	3·5 to 5·5	4·42	4·92	4·50
Ash	0·5 to 0·8	0·70	0·70	0·70
Water	86 to 87	87·38	87·41	86·00

The reaction of cow's milk when first drawn is slightly acid. The acidity increases decidedly as the milk becomes older. The average specific gravity of sound dairy milk, according to Leeds, should be 1·0297. It is lowered by an excess of fat and raised by its removal. Milk drawn from clean udders into sterilized vessels contains no bacteria, but quickly becomes infected when exposed to the air. Ordinary milk contains bacteria in large numbers. The best milk for food purposes is that obtained from the ordinary herd. The milk of one cow is not so good as the combined milk of several cows, as it is more subject to change with changes in diet and with the various conditions of health or disease of the animal.

The albuminous principles of milk consist almost exclusively of casein and lactalbumin. The addition of acid precipitates the casein of cow's milk in heavy, coarse coagula. Lactalbumin resembles serum albumin closely, and is precipitated by boiling. The casein is four times as great in quantity as the lactalbumin.

The fat is practically the same in all varieties of milk. It has been demonstrated that the corpuscles are not surrounded by an albuminous envelope, but exist as finely divided particles covered by numerous albumin molecules which adhere to the surface. As the fat is lighter than the surrounding fluid, a portion rises to the surface to form cream. The amount of cream varies greatly in different samples of milk—from 10 to 20 per cent. or more. Butter consists almost entirely of fat of milk, with a very small quantity of casein and lactose. But onesixth of the fat is left in the buttermilk.

The carbohydrates are present in the form of lactose or milk sugar. No starch is present. Lactose is intermediate in its chemical properties between starch and cane sugar. As milk is designed as a food for the young who are unable to maintain the bodily heat as readily as adults do, it is necessary that that form of the carbohydrates should be furnished which is assimilated with the greatest ease. Lactose is such an element, being far more readily digested and assimilated than starch. Milk undergoes two forms of decomposition—the lactic-acid, due to the action of certain bacteria on the lactose, and the butyric fermentation, due to the action of certain bacteria with the development of an alkaline reaction.

The mineral matter of cow's milk is large in amount and consists chiefly of phosphate of calcium. This element is found in combination with the casein. The sodium salts exist in solution in company with the lactalbumin. The amount of lime in cow's milk is also especially large.

The accompanying table, prepared from various sources, shows the average composition of milk and various milk products. Lactic acid being omitted, the total of some columns is less than one hundred.

	Proteid.	Fat.	Sugar.	Ash.	Water.
Human milk	1·50	4·00	7·00	0·20	87·30
Cow's milk	4·00	4·00	4·50	0·70	86·80
Skimmed milk	3·06	1·80	4·37	0·70	90·07
Condensed milk, diluted nine times	1·35	1·35	6·73	0·26	90·31
Buttermilk	4·00	0·70	3·40	0·56	91·17
Whey	0·82	0·25	3·65	0·65	93·30
Cream	2·70	26·70	2·80	1·80	66·00
Kumyss	2·04	1·91	3·26	0·44	90·99
Matzoon	3·98	4·91	2·03	0·78	87·69
Kefir	3·80	2·00	2·00	0·02	91·62
Butter	0·70	85·00	0·50	1·50	11·90
Cheese	29·23	23·84	....	5·09	41·84

The Production of Disease through the Agency of Milk.—The fact that milk may be an active agent in the transmission or production of disease has been abundantly proved. This result is accomplished in three ways: 1. The direct transmission of disease to the human subject from infected animals. 2. The transmission of infectious diseases through the contamination of milk by their specific germs. 3. The production of diseases through micro-organisms which develop in milk. The disease transmitted most commonly by the first method is tuberculosis. It has been conclusively demonstrated that the milk of tuberculous cows may be infected when the disease is localized in the lungs of the animal and when no disease of the udder is present. It has been estimated that from 10 to 15 per cent. of the dairy stock in the Eastern States is tuberculous. Osler believes that this is a low estimate. Systematic sanitary inspection of the cows and the destruction of all infected animals is the only certain means of prevention, though the bacilli in milk may be destroyed by sterilization. Adults may take infected milk with comparative impunity, but with young children the danger of infection is great. It is possible that the frequency of mesenteric tuberculosis in children is explained by these facts. It was for a time believed that scarlet fever could also be transmitted from cows. The Hendon epidemic in England was the cause of much discussion, but it is now the almost universal belief that diseases originating as that did are not true scarlet fever, but a modified form of cow-pox. It is not impossible that cows suffering from other infectious diseases to which the bovine species is liable may transmit disease to the human subject.

It has been demonstrated that typhoid fever, scarlet fever, and diphtheria may be transmitted by milk which has been contaminated with the germs of these diseases. Hart has reported no fewer than fifty epidemics of typhoid fever occurring in England. fourteen of scarlet fever, and seven of diphtheria which can be clearly traced to infected milk. The germs may reach the milk through infected water which is used for the purpose of adulteration, or for washing cans and utensils. Epidemics of scarlet fever have resulted from the use of milk obtained from a shop in which the children of the dealer were suffering from the disease. It is well known that milk readily absorbs odours, and its ability to absorb germs of disease seems equally great. The chief means of preventing the transmission of disease by this method lies in strict sanitary control of milk from the moment it is taken from the cow until it reaches the consumer.

The development of certain pathogenic micro-organisms in milk is the cause of an enormous amount of disease. Of the 1,943 fatal cases of summer diarrhœas reported by Holt, only 3 per cent. were in children exclusively breast-fed. Over three thousand children die every year of these diseases in New York. They are widespread, and are by no means confined to large cities. These diseases are known to be due to certain germs. So positive is our knowledge upon this point that Vaughan, one of the best American authorities upon the subject, has recently applied to cholera infantum and entero-colitis the names respectively of acute and subacute milk infection. While the propriety of this classification may be questioned, the fact which suggested it is beyond doubt. These diarrhœas are due to toxicogenic bacteria which develop in milk. It is not a specific germ like that of tuberculosis. Several species of a large class may produce practically the same results. The ptomaines of these germs have been isolated and studied, especially by Vaughan. Of these, tyrotoxicon is one of the most active and fatal, and produces the symptoms of classical cholera infantum. The ordinary forms of summer diarrhœa are due to less active ptomaines.

The Effect of Food and Drugs on Milk.—Certain drugs and poisonous articles taken by the mother quickly make their appearance in milk. It is impossible to make any definite statements, however, upon this subject. In healthy milk, which is a true secretion, they may appear but slightly. In thin, watery milk, which is more of a transudation than a secretion, they may be found in dangerous quantities. Food which may be perfectly harmless in the case of a healthy mother may cause serious symptoms in the child of a mother whose milk is thin and watery. The varying results recorded by different observers upon the effect of drugs upon the milk are probably explained in large measure by these facts. The mental condition of the mother has a most potent influence upon the character of the milk. The cow is an especially nervous and excitable animal. It is well known that excitement and rough treatment have a deleterious effect upon the milk.

The Preservation of Milk.—It has been demonstrated that milk free from germs does not decompose. The prevention of decomposition, therefore, consists in excluding germs or in the destruction of those which have gained admission. The prevention of the various diseases which have been referred to in the last section also depends upon the destruction or exclusion of the germs which produce them. This is effectually accomplished by the process of sterilization as devised by Soxhlet. As in surgery asepsis is now obtained by comparatively simple means, the extreme measures of early antiseptic surgery being found unnecessary, so in the preservation of milk it is now known that a process less extreme than sterilizing is effectual for practical purposes. In sterilizing, milk is heated by the action of steam to a temperature of 212°. Milk treated by this method undergoes certain changes. The starch-liquefying ferment is destroyed, the milk sugar is changed, and the casein is so modified that it is acted upon less perfectly by pepsin. It has been found that milk that has been kept at a temperature of 75° C. (167° F.) for fifteen minutes is practically as safe as sterilized milk, and is free from the changes which take place

during sterilizing. This process is known as Pasteurizing. By this process the germs of tuberculosis, diphtheria, typhoid fever, cholera, pneumonia, and various forms of streptococci and staphylococci are destroyed. It does not modify the size of the curds formed in the process of digestion, nor does it change the taste of the milk. Pasteurizing is preferable to sterilizing. In the writer's opinion, the indigestibility of sterilized milk has been exaggerated. While it is a fact that it is not so readily digested by many children as plain or Pasteurized milk, it is also a fact that large numbers of children digest it with equal ease, and every clinical observer has seen cases in which it is digested more perfectly than plain milk. It is too valuable a food agent, and has saved too many lives, to be abandoned. Although Pasteurizing is an improvement upon sterilizing, the latter should not be abandoned in cases where the former can not be accomplished. During hot weather, in cities where milk is not fresh, it is far safer to err in the direction of overheating. Several methods of sterilizing have been devised, the Arnold sterilizer being one of the best. It is impossible, however, with that apparatus, even with the most recent modification, to be certain that the milk is not raised to a temperature above 167°. The best system of Pasteurizing is that advised by Freeman, of New York. It is based upon the principle that in immersing cold milk in boiling water an equalization of the temperature between the milk and water takes place, giving a resultant temperature which depends upon the relative quantities of the liquids used. In this apparatus the milk, placed in bottles, is immersed in hot water. The proportion between the two has been carefully calculated, so that a resultant temperature of 167° in the milk is obtained. Rapid cooling by means of running water is an important part of the process of Pasteurizing.

Attempts have been made to prevent the decomposition of milk by the use of chemicals. Thus far they have been unsatisfactory. It seems highly improbable that any chemical will be found of sufficient power to destroy the germs which may be developed in milk without being at the same time deleterious to the human subject. Of the various chemicals proposed, peroxide of hydrogen is probably the least objectionable.

Condensed Milk.—The keeping qualities of milk are somewhat improved by condensing. Plain condensed milk keeps but little longer than uncondensed. When preserved in cans by the addition of sugar, milk will keep for a considerable time, but this preparation has many drawbacks. It is commonly asserted that condensed milk has one fifth the bulk of plain milk, but Cornwall, in analyses of the various condensed milks in the American market, found that the condensation varied from 2·27 to 3·12 times, the average being 2·74. Condensed milk has, therefore, not quite one third the volume of the original. Most condensed milk, when reduced with water, shows a deficiency in fat. A mixture composed of 2 parts of water and 1 part of condensed milk does not produce a fluid identical with ordinary cow's milk.

The Dietetic Uses of Milk.—Although milk is a perfect food for the young, it is not adapted to the needs of adults and is not suitable as an exclusive article of diet. It is, nevertheless, one of the most valuable of food elements, and enters largely into various combinations in the process of cooking. It may also be taken to advantage by most people in its natural state. An exclusive milk diet soon becomes very repugnant and is enforced with considerable difficulty in many cases. The tongue becomes coated, an unpleasant taste develops in the mouth, there is a feeling of distress in the region of the stomach, and constipation is the rule. The weight decreases for a time, but this decrease soon ceases and the weight continues unchanged. A feeling of weakness is commonly experienced, and sometimes faintness and even vertigo. These symptoms often occur, but in a lesser degree, when milk is taken as a part of a mixed diet. They may be much mitigated and sometimes entirely prevented by diluting the milk with water, either plain or effervescing. The addition of limewater also aids in preventing them. The administration of a compressed tablet of rhubarb and soda, or "soda mint," will enable some persons to take milk freely who could not otherwise do so. In some cases boiling renders it more digestible, and in others it must be peptonized. When whole milk is not tolerated skim milk may be well borne. The milk cure consists in the administration of milk alone to the exclusion of all other drink and food. The amount administered daily depends largely upon the patient. As a rule, 4 fl. oz. are given every three hours at the outset. It should not be given at shorter intervals, as this time is required for complete digestion. When the milk is not well digested Mitchell adds limewater in the proportion of one fourth the quantity of milk. This should be reduced slowly and plain milk given as soon as possible. The quantity should be gradually increased until about two quarts are given daily. The uses of milk in the various diseases are described in the article on Dietetic Treatment; the peptonizing of milk is described in that on Alimentation.

Infant Feeding. — Notwithstanding the various objections that may be justly urged against cow's milk, it is the almost universal opinion of those best qualified to judge that it affords the best artificial food for infants. So strong is the writer's belief in this opinion that he has no hesitation in discussing the subject of infant feeding in the section on milk. The difficulties encountered in adapting cow's milk to infants' use are found in the varying proportions of the different component elements and in differences in the proteid element. It is believed by some also that the digestibility of the fat of cow's milk is much less than that of the fat of breast milk. While the proteid of mother's milk consists of about two parts of lactalbumin and one part of casein, that of cow's milk consists of one part of lactalbumin and over four parts of casein. The

coagulum of cow's milk is almost five times as heavy as that of breast milk. The coagula of cow's milk are large and dense, and those of breast milk are fine and flocculent. Even when the proportions of proteid are rendered similar by diluting we are unable to modify these conditions. It is here undoubtedly that the chief difficulty in the successful feeding of many infants lies. This objection is far less, however, than the drawbacks presented by any proprietary food yet devised.

The composition of breast milk may vary as follows, the figures representing percentages: Proteids, 1 to 2; fat, 3·5 to 4·5; sugar, 6·5 to 7·2; salts, 0·18 to 0·25.

The following table shows the average composition of cow's milk and breast milk:

	Proteid.	Fat.	Sugar.
Cow's milk	4·00	4·00	4·5)
Breast milk	1·50	4·00	7·00

The problem here presented is to so change cow's milk as to render it similar in composition to breast milk. To accomplish this we must decrease the proteid and increase the sugar. The only feasible method of decreasing the proteid is by diluting the milk. This diminishes the fat, which renders it necessary to increase that element also. We must therefore decrease the casein by diluting the milk, and add fat and sugar. Ordinary cow's milk, diluted twice, yields the following proportions: Proteid, 1·58; fat, 1·16; sugar, 1·33; salts, 0·23. The proteid and salts are thus seen to be in almost the exact proportions in which they occur in breast milk, but the mixture is largely deficient in sugar and fat. The first of these deficiencies is readily overcome by the addition of sugar. Milk sugar is to be preferred. It may now be obtained pure, and is not expensive. Cream may be added to supply the fat needed, but "top milk" is preferable. This is obtained by skimming with a spoon about 7 fl. oz. from the top of a quart of milk which has stood in a bottle or can for six hours.

Sufficient food should be prepared each morning to last for twenty-four hours. Nursing bottles should be at hand equal in number to the number of feedings the child is to receive. The food, when prepared, should be divided among these bottles, each bottle receiving the proper amount for one feeding. This prevents exposure of the milk to the air at each feeding, and adds materially to its keeping qualities. The following table, from Holt, shows the proper proportions required for an infant getting 24 fl. oz. a day:

Top milk....... 8 oz.;
Water..... .... 16 oz.;
Milk sugar..... 6 heaping teaspoonfuls.

This yields a mixture found upon chemical examination to closely resemble breast milk in its composition. These proportions may be continued until the child is seven or eight months old, the daily quantity being increased from month to month. Instead of 8 fl. oz. of top milk, 4 fl. oz. each of milk and cream may be used. If cane sugar is employed, the amount should be but two thirds that of the milk sugar advised. Barley water is preferred by some instead of plain water, in the belief that it prevents the milk from curdling in large masses. Recent observations have thrown considerable doubt upon this. It is important to make the directions for the feeding of babies as simple as possible and to spare nurses and mothers unnecessary labour. As the value of barley water is doubtful and its preparation involves some labour and care, it is wise to employ simple boiled water. Barley water may be substituted if the baby fails to properly digest the mixture when made with plain water. In that condition limewater may also be added. Barley water is made by adding two teaspoonfuls of Robinson's prepared barley flour to one pint of water and cooking it for twenty minutes. It may be also made from the barley grain, a tablespoonful being used to each pint of water. This should be boiled for at least six hours.

When the baby reaches the age of seven or eight months twice as much milk may be taken from the top of the bottle and diluted with an equal quantity of water, according to the following table:

Top milk........... 19 oz.;
Water.............. 19 oz.;
Milk sugar......... 9 teaspoonfuls.

No positive rule can be made which will apply to every case. Some children digest casein with the greatest difficulty; some require more milk, some less than the amounts here specified. These tables, as given, are adapted to the vast majority of cases. The food must sometimes be modified and changed to suit the individual, but the utmost caution should be observed against falling into two serious errors—feeding too much and too often. No healthy infant requires food more frequently than once in two hours, and after the age of three months none should be given between ten or eleven o'clock in the evening and the early morning. The quantities here given are adequate for all ordinary cases. The following table presents in compact form the information needed regarding the time of feeding and necessary quantities:

SCHEDULE FOR FEEDING AN AVERAGE CHILD IN HEALTH (HOLT).

AGE.	No. of meals.	Interval by day between meals.	Night feedings (10 P. M. to 6 A. M.).	Quantity for each meal.	Quantity for 24 hours.
		Hours.		Ounces.	Ounces.
1 week	10	2	2	1	10
2 to 3 weeks	10	2	2	1½	15
4 weeks	9	2	1	2¼	20
6 "	8	2½	1	3	24
3 months	7	3	1	4	28
5 "	6	3	..	5½	33
6 "	6	3	..	6	36
9 "	5	3	..	7½	37½
12 "	5	3	..	8	40

The question of Pasteurizing or sterilizing depends entirely upon the conditions present.

For a child living in the country, where the milk is obtained fresh twice a day, it is unnecessary. For a child living in the city, where the milk is many hours old when first received, during hot weather it should under no circumstances be omitted. It should be clearly understood that Pasteurizing and sterilizing accomplish but one result—the destruction of bacteria. Sterilized milk requires precisely the same treatment as regards diluting and the addition of cream and sugar as plain milk does. In performing this process the milk should be placed in separate bottles, as already described, and should be sterilized as soon as possible after it is received, the whole quantity for twenty-four hours being made up and sterilized at one time.

[In an article published in the *Journal des praticiens* for December 21, 1895, the writer, speaking of the occasional indigestibility of cow's milk, states that it has been shown that calcium chloride cuts short the gastric digestion and cures the resulting diarrhœa. The following solution may be employed in the latter case:

Calcium chloride.........	15 grains;
Water..................	3 oz.

A dessertspoonful of this solution may be added to a pint of milk. A solution of lactic acid in the proportion of 75 grains to 15 oz. of water may also be used with good effect.]

Condensed milk, though largely used, is undesirable as an infant food. Different samples vary greatly in their composition, and no rule can be given for its preparation which will insure a definite result. When diluted sufficiently to bring the casein to proper proportions, it is deficient in fat to an extreme degree. Some children seem to take it, however, without serious detriment. They become large and fat, but are prone to be flabby and anæmic. They are subject to rickets, and have but little resisting power when attacked by disease.

The proprietary foods have been shown by repeated examinations to be largely deficient in fat. This important element in the best food in the market does not reach half the normal amount found in breast milk. In some foods, when prepared according to directions, the amount of fat is as low as 0·70 per cent. With few exceptions, they contain free starch, and in some foods it is present in large amounts. The writer, in a recent study of scurvy in infancy, found that 63 per cent. of the patients had received a diet of proprietary foods or condensed milk. The growing prevalence of this disease and the various conditions allied to it is unquestionably due in large measure to the increasing use of these foods.

Modified Milk.—This term has recently come into use in a special and restricted sense. It is applied to milk which has been separated into its component elements in a milk laboratory and recombined on a prescription of the physician. A laboratory for this purpose was first established in Boston through the agency of Dr. Rotch. More recently a branch has been established in New York. It is probable that laboratories of this description will soon exist in all the larger cities. Fresh milk produced under the best sanitary conditions attainable is the first requisite. When the milk is received at the laboratory the fat is first removed by the centrifugal machine. The elements in the hands of the chemist are therefore: 1. Cream of stable percentage; 2, clean milk without cream; 3, a 20-per-cent. milk-sugar solution; 4, distilled water; 5, limewater. With these elements the chemist can reconstruct a milk of any desired strength. The physician orders this milk by prescription, as he orders his drugs from the apothecary. He may order milk containing 4 per cent. of fat, 7 per cent. of sugar, and 2 per cent. of proteid, with the assurance that his patient will get these proportions unvaryingly from day to day. He may at any time change any of these ingredients by simply writing a new prescription. The physician who prescribes diet according to the formulæ given in the earlier portions of this article is not sure that a child who receives a given percentage to-day will receive precisely the same to-morrow, owing to the fact that milk is variable in its constituents. The advantages arising from this system are the assurance of securing fresh, clean milk and the ability to secure a food which does not vary from day to day. It renders food-prescribing certain and definite, and is a most important step in the direction of precise and accurate treatment.

[**Cream Milk.**—Dr. Edmund Cantley, physician to the Belgrave Hospital for Children, London, has given this name to a special milk for infants prepared somewhat in accordance with Dr. Rotch's idea. In an article published in the *Lancet* for January 11, 1896, he says that, taking the results of his own analyses of cow's milk and Leeds's analyses of human milk as a basis, he suggested to the analyst of an English dairy company, at the last meeting of the British Medical Association, that the company should prepare a special milk for infants according to the following process: Taking an equal quantity of mixed cow's milk and a 10-per-cent. solution of lactose, the whole is passed through a separator so arranged that the two outgoing streams are equal. It is thus divided into two equal parts, one of which contains practically the whole of the cream and may be termed *cream milk*, while the other contains practically no cream and may be termed *skimmed milk*. The composition of these two fluids would therefore be as follows:

	Cow's milk.	Separated milk.	
		Cream milk.	Skim milk.
	Per cent.	Per cent.	Per cent.
Proteids............	4·0	2·0	2·0
Fats................	3·7	3·5	0·2
Lactose.............	4·4	7·2	7·2
Ash.................	0·7	0·35	0·35

The Aylesbury Dairy Company prepared the milk of the following quality, and supplied it for trial in the hospital:

	Cream milk.	Human milk.
	Per cent.	Per cent.
Total solids	13·11	13·20
Proteids	1·82	2·00
Fats	4·02	4·00
Lactose	6·88	7·00
Ash	0·39	0·20

The advantages of a milk supply of this nature, says Dr. Cautley, are numerous and obvious. 1. By the process of separation a large number of deleterious substances which accidentally contaminate milk are removed. 2. By the process of Pasteurization the countless organisms present in milk are destroyed; it has been shown that a temperature of 160° destroys the bacilli of tubercle, typhoid fever, diphtheria, and many others; the liability of the transmission of disease to the infant by the milk supply is consequently abolished. 3. A substitute for human milk is supplied ready for use. 4. The milk can be diluted without altering the relative proportions of the different solid constituents to each other.

Dr. Cautley's undertaking can not have failed to be productive of great good, but he is in error in supposing that Dr. Rotch's plan leaves anything to the "careless or stupid" mother or nurse.

A special preparation of milk for the subjects of *diabetes* was made the subject of a communication by Dr. Sydney Ringer in the *British Medical Journal* for December 7, 1895. He refers to recorded experiments of his with caseinogen and casein and to a method of preparing caseinogen from milk, which is freed from all sugar (and salts). The following is the method: Add to 1½ pint of milk about 90 c. c. of a 10-per-cent. solution of acetic acid. This precipitates a curd caseinogen. It should be allowed to settle, and the clear fluid siphoned off and distilled water added. After settling, this should be decanted or siphoned off, and the curd should be filtered and well washed with distilled water. If it is then rubbed up in a mortar with some calcium carbonate, and water is added, all the caseinogen becomes dissolved; the calcium carbonate soon settles, and the milky fluid can be decanted off. The dissolved caseinogen behaves just like milk. If rennet and a calcium salt are added, and the mixture is heated to 104° F., it quickly clots, and the caseinogen becomes changed into casein, which precipitates by combining with the calcium salts.

A solution of caseinogen is milk without the sugar of milk. It is found that the caseinogen settles better after the addition of the acetic acid if the milk is diluted with an equal quantity of water, and the precipitated caseinogen is filtered and washed on a calico filter. On the addition of about 2 per cent. of glycerin to the mixture of caseinogen, says Dr. Ringer, a not unpalatable form of milk is produced.]

Cream consists of milk which contains a large proportion of fat globules. It is obtained either by allowing the milk to stand until the fat has risen to the surface, which it will do because of its low specific gravity, or by means of a centrifugal machine. The composition of cream is exceedingly variable, depending upon the amount of fat in the milk, the care of the milk, the temperature at which it is kept, and various other factors. The composition is, in fact, so variable that no statement of percentages can be considered accurate. Contrary to common belief, it contains about the same proportion of casein and lactose as milk does, differing from milk only in the excessive proportion of fat. Cream is usually obtained by allowing milk to stand in shallow pans in a cool place. When the cream has risen, it is skimmed from the top of the milk. The chief objection to this form of cream is that it is at least twenty-four hours old and liable to much contamination. "Centrifugal cream" is obtained by means of the centrifugal machine. About seven thousand revolutions to the minute are employed in obtaining ordinary cream. The advantage of this cream is that it is no older than the milk from which it is taken, and is less variable in its composition. Cream obtained by very rapid revolutions of the wheel seems to be somewhat changed in its character, and is not so well adapted to the use of infants and invalids. Cream should be removed by as low a number of revolutions as will suffice to separate it.

The quantity and quality of cream varies considerably with the breed of cows from which it is obtained, the milk of Alderneys and Jerseys being especially rich in fat. The amount of cream depends upon the time during the milking at which it is taken, that which is drawn last being far richer in fat globules than that taken at the first or middle of the milking. This is a matter of much importance in obtaining breast milk for examination. The first milk taken is always poor in fat, and the last is very rich. "Middle milk" only should be taken. Fair market milk should contain at least 10 per cent. of cream. A good grade of milk contains 15 per cent. or more. According to Currier, milk showing 10 per cent. of cream will contain 3½ per cent. of fat, and that showing 15 per cent. of cream will contain 4·75 per cent. of fat.

The fat of cow's milk consists of glycerides of stearic, oleic, butyric, palmitic, myristic, and other soluble fatty acids. Ordinary "centrifugal cream" contains about 20 per cent. of fat. The cream used in milk laboratories contains 16 per cent. of fat. Accurate tests of the amount of fat contained in milk or cream can be made only by the chemist. A simple and fairly accurate test can, however, be made by the cremometer of Chevallier, which consists of a cylindrical vessel with a scale showing percentages marked on the side. The percentage of cream is read from the top after allowing the milk to stand for twenty-four hours. The apparatus devised by Holt for testing breast milk is based upon Chevallier's instrument, and is a very simple means of making a quick and fairly accurate analysis.

Cream is used in enormous quantities as an article of diet, being one of the most palatable as well as digestible forms of fat. It is indi-

cated in wasting diseases and in all conditions where fat is required. It is considerably used as a substitute for cod-liver oil, owing to its palatability and the readiness with which it can be taken.

[The use of milk as an exclusive or predominant article of diet in the treatment of particular diseases is treated of in the article on DIETETIC TREATMENT. In connection with the section on *nephritis* (page 338) it may be added here that M. de Grandmaison (*Médecine moderne*, 1894, No. 76) makes a distinction from a therapeutical point of view in patients suffering from albuminuria. Although patients with *parenchymatous nephritis*, or threatened with *uræmia*, whatever may be the renal lesion which causes it, may find a milk diet absolutely satisfactory, he thinks that it has not the same effect in *gouty albuminuria*. He considers that an exclusive milk diet is useless among patients of this class and even harmful, as it does not furnish sufficient nourishment for persons who have to work, and they form the majority of this class of patients. As uric acid is the irritating product of the glomerules and causes the appearance of albuminuria, M. de Grandmaison does not see what influence a milk diet can have on the elimination of the uric acid. He advises that patients of this class should be subjected to the ordinary diet, and that, in certain cases, they should be given tonics—such as iron—or modifiers of vascular tension, such as strychnine, or substances which act directly on urinary infiltration, such as strontium lactate. The gouty diathesis must also be kept in view, and, in instituting an appropriate treatment, accumulation of uric acid in the blood and irritation of the glomerules must be avoided, as they give rise to albuminuria.

Gaucher and Gallois, in a recent work on the treatment of diseases of the kidneys (quoted in the *Journal des praticiens* for December 21, 1895), state that if milk is badly digested, particularly in *uræmia*, it is often because the chemical operations within the stomach indicate an excess of pepsin. In this case kephir gives good results. If it is to be absolutely substituted for a milk diet, that which is slightly fermented only should be recommended, as it contains less alcohol and is therefore a wholesome remedy in the *gastro-intestinal troubles of nephritis*, and especially of interstitial nephritis. As kephir is a diuretic, it may act advantageously in other uræmic manifestations. If it is unpleasant to the taste, M. Hayem recommends diluting it with a little Seltzer water or adding sugar to it.]—FLOYD M. CRANDALL.

MILK ADULTERATION.—The question as to what should constitute normal milk is one which has been under discussion for many years and has not yet been settled to the entire satisfaction of experts. Various standards have been proposed, ranging from 11·50 to 12·50 per cent., and even higher, of total solids; but 12 per cent., of which 3·50 per cent. should be fat, is generally taken as a fair average for commercial milk obtained from a herd of cows. There is no doubt that in some instances milk containing a smaller amount of solids has been furnished by single cows in health, but such cases are so rare that they are not worth considering, although some analysts would lower the standard to meet such circumstances. Save where the milk could be sold, no sane person would keep such an animal, either for butter or for cheese purposes, and it certainly would not be just to the community to allow the sale of such an article. The standard as recognised by the various boards of health is low enough, and in justice to the consumer it should be raised so that any milk which contains less than 13 per cent. of solids should be held to have been sophisticated. This would undoubtedly throw out the milk of hundreds of healthy animals, but in the present state of agriculture there is no excuse for their existence. The standard suggested would simply mean slightly better cows and improved methods of feeding and, what is more important from a farmer's standpoint, an increased production of a higher grade of milk. It is certain that the herds from which the supply for creameries and cheese factories is drawn will give milk of a standard higher than the one mentioned. Assuming that 13 per cent. is a proper standard, there should be in fair milk about 3·80 per cent. of fat, 0·70 of salts, and 8·50 of sugar, casein, and albuminoids. Slight variations from this are allowable, and in the cases of cows from cheese-making breeds the fat may fall as low as 3·25. Milk from fine-bred cows fed upon scientific principles may contain 16 per cent. of solids or even more, but it is hardly possible to expect such a value to be attained under ordinary conditions.

A milk analysis, unless it is undertaken for legal purposes, is among the simpler laboratory procedures, and requires only a fairly good balance, several platinum or nickel dishes, a water bath and a hot-air bath. A small quantity (about 5 grammes [75 grains] is a convenient weight) is weighed in a tarred dish and evaporated to dryness over the water bath, and then transferred to the hot-air bath kept as nearly as possible at the temperature of 212° F., and allowed to remain there until its weight becomes constant; this will, under ordinary circumstances, require from two to three hours. The loss of weight observed after these manipulations will give the weight of water originally in the sample. The fat may be extracted by pouring anhydrous sulphuric or petroleum ether over the residue in the dish, care being taken that none of the pellicle of casein, etc., is lost during the operation; probably four washings with the ether will be sufficient to remove all traces of the fat. What remains in the dish should be weighed rather than the fat, which may be recovered by evaporating off the ether, as the chances of loss, etc., are less. If for any reason an estimate of the casein, etc., or sugar is desired, the residue should be repeatedly washed with dilute alcohol and, after drying in the air bath, weighed. The remainder of the contents of the dish will consist of the

salts and the casein and albuminoids. Incineration at a low red heat will leave the former, and by a simple calculation their weight will furnish that of the casein, etc. When it is necessary to determine the ash a platinum dish will be needed, but otherwise one of nickel or a lead capsule, such as is used to cover the mouths of bottles, will be entirely appropriate.

The method described is for all practical purposes perfectly satisfactory, but yields a slightly smaller amount of fat than the Adams method, in which a known weight of milk is absorbed by a roll of specially prepared paper or cloth which, after drying, is treated in an extraction apparatus. It is urged by some against this method that during the process of drying a portion of the milk sugar is changed into some body soluble in ether. Whether this is so or not, it is a point of no great practical value, as the amount of fat which whole milk should contain is determined by this method, and a trifling error in the quantity of sugar is of little moment.

When an analysis is not practicable or necessary, the volume of cream may be easily determined by allowing the milk to stand in a decimally graduated glass tube; as the cream rises to the top the percentage present is readily seen at a glance. This procedure, as ordinarily practised, takes several hours and is not absolutely accurate, as in some milks the entire amount of the cream does not separate, and, moreover, in warm weather the milk may become sour before separation occurs. If, however, the milk is diluted with an equal bulk of water of such a temperature that that of the mixture is about 100° F., and rendered faintly alkaline, and the tube placed in cold water, separation is very complete and takes place within an hour. As the milk has been diluted with an equal amount of water, the percentage of cream shown in this test must be doubled to give the correct figure. Various portable machines are in the market in which the milk is placed in small tubes and rapidly rotated for several minutes. The cream, being lighter, rises to the top and is easily estimated. On the addition of a little acetic acid, the casein, etc., will also separate and will be in a distinct layer. These machines are quite extensively employed in estimating the value of milk at cheese factories and creameries, and are sufficiently accurate for all practical purposes. It is hardly probable that whole milk will ever show less than 12 per cent. of cream as determined by any of the above-mentioned methods, and in the vast majority of samples it will run much higher. Probably about 16 represents the percentage in milk from an ordinarily good cow, and a buyer would be justified in declining to accept any below that point, although it might not have been skimmed. The instrument most commonly employed for testing milk is the lactometer, which is simply a special form of hydrometer, usually graduated from 0 to 130 or thereabouts, 100 of its scale being 1·029 of a hydrometer adapted to taking the specific gravity of fluids heavier than water. As might be imagined, it may be very untrustworthy in the hands of an ignorant or unskilled person, but when the reverse conditions exist it affords the readiest method of determining the value of a milk. To use it properly, the colour of the milk, its viscidity, and its taste must be taken into account. Whole milk should be of a yellowish-white colour, adhere somewhat to any objects with which it comes in contact, and have a distinctive flavour which can be best defined by saying that it is neither flat nor watery. In using this instrument, a vessel of sufficient depth and diameter to allow of its floating freely should be employed, and the temperature of the milk raised or lowered, as the case may be, to 60° F. by immersing the vessel containing it in one with either warm or cold water in it. If it is not convenient to bring the milk to this temperature, a fairly close approximation to the correct gravity may be made by adding or subtracting two degrees of the lactometer scale for every three degrees the temperature is above or below 60°. Each division upon the lactometer scale below 100 is assumed to represent the addition of one per cent. of water; that is, if the reading is 90, it is pretty certain that 10 per cent. of water has been added. This method of calculation is not very accurate, as analyses show a larger addition than the lactometer does. Before the lactometer is used the stem must be dry and perfectly clean, as otherwise the milk will creep up on it, and both vitiate the reading and, by the added weight, submerge the instrument deeper. By greasing the stem carefully, so much milk may be made to ascend upon it that, if opportunity is allowed, the entire instrument will sink until it is wholly covered. Another precaution to be observed is the agitation of the milk until any cream which may have separated is recombined and all the contained air is expelled. Neglect of these precautions may lead to an error of many degrees in the reading.

After being placed in the milk the lactometer should be allowed to remain until it is at rest, and the reading made at the top of the meniscus, as that is the point usually selected; upon its withdrawal, the milk, if unsophisticated, should run slowly off the instrument and form fine bubbles. Watered milk runs off quickly, is thin, and has a bluish colour. It would be impossible to describe the exact action of good milk under these conditions, and one should experiment a little with a sample known to be unsophisticated by adding small amounts of water and comparing the diluted milk with that untouched. A reasonable degree of expertness can thus be acquired in a very short time.

It has been clearly established that milk from a healthy cow under normal conditions never falls below 100 on the lactometer or 1·029 on a hydrometer, and that if a sample shows below that point it is colostrum, or has been drawn from a diseased cow, or one known as a stripper, or from one insufficiently or improperly fed, or contains an abnormal amount of cream on account of lack of care in taking the sample, or a large admixture of air. Colostrum, containing a large amount of fat, will give a reading far below 100, but its yellow colour and

thick appearance will usually disclose its nature; the crucial test is examination under the microscope for the characteristic colostrum corpuscles. Although used by many persons—more, however, as a cathartic than as a food—it should be rejected in all cases, even when mixed with large amounts of good milk, as it exerts upon some individuals a very unpleasant cathartic action, and is particularly unsuited for infants. All febrile disorders in cows should be contra-indications to the use of their milk; animals in excessively dry weather, with poor pasturage and foul water, give milk of low gravity, or rather a fluid resembling it, which is apt to excite disturbances of the digestion; "strippers," or cows being dried off before calving, yield a watery, frothy milk containing mucus and but little fat, which is equally unsuitable as a food. The last milk drawn from a cow contains more fat than the first portions of a milking, and may fall below the 100 mark on the lactometer, but it is rare that it is kept separate, and the fact is more interesting from a theoretical standpoint than from the practical one. While the milk is still warm from the cow the lactometer may show as low as 70 or even lower, but cooling and agitation will quickly raise the milk to its normal point.

The milk from an average cow will usually stand at about 108; that from a high-grade butter cow will often run below 105, and at times may approach nearer to 100; and that containing large amounts of casein and a correspondingly small quantity of fat, such as is furnished by animals of cheese-making breeds, may reach 120. It will thus be seen that without the aid furnished by the senses a mistaken estimate of the quality of a milk may easily be made, and that in all instances the greatest care must be exercised. When milk ranges from 105 to 108 and shows above 14 per cent. of cream in volume, it is probable, in the majority of cases, that it has not been tampered with to any great extent.

Lactoscopes are instruments in which black lines, figures, etc., are looked at through thin layers of milk. They are employed to a considerable extent in estimating the amount of fat, and in the hands of some persons are very satisfactory, but others, rather curiously, are unable, even with extended opportunities, to acquire any degree of accuracy in their readings. Probably the best of these is Feser's, which consists of a graduated glass tube the lower portion of which is contracted to about one third the diameter of the upper part, and contains a cylinder of white glass with horizontal black lines. A known quantity of milk, indicated by a graduation, is introduced and water is added slowly until the lines on the cylinder can be seen distinctly at a distance of about a yard, when the height to which the mixture rises indicates on a scale the percentage, by weight, of fat, the theory being that the translucency of the mixture varies regularly with the amount of fat it contains. A number of cheap modifications are to be had, but they are poorly made and are not to be relied upon.

The instrument also furnishes a method for ascertaining the percentage of casein and sugar, and may be depended upon to give results within 6 or 7 per cent. of those derived from chemical analysis. The percentage of fat, as ascertained with the lactoscope, is multiplied by a constant, 0·001, which represents the decrease in specific gravity of water to which 1 per cent. of butter fat has been added, and the product subtracted from 1,000; this remainder is now deducted from the true specific gravity of the milk, determined either with a hydrometer or by calculation from the lactometer reading, and the remainder thus obtained is divided by 0·00375, which represents the increase in specific gravity of water caused by the addition of 1 per cent. of the casein, sugar, and salts in the proportions in which they exist in milk. The result will be the percentage of these bodies, and with the addition of the fat will give the total solids in the sample. If from the solids not fats 0·70, the average percentage of salts, is deducted, we shall have the percentage of casein and sugar.

The commonest frauds upon the milk consumer consist either in the addition of water, in the removal of a portion of the cream, or in both, but the first mentioned is by far the most frequent and, as a rule, the most profitable. While diminishing greatly the value of milk as a food, the addition of water is far more serious, on account of the possibility of its containing disease germs, especially those of typhoid fever. Epidemics of this fever in which milk, which appears to be a most favourable medium for the rapid propagation of its specific micro-organism, has been the undoubted vehicle for the dissemination of the disease, can be reckoned by the score, and, so long as the health officers in the milk-producing districts continue to exhibit their customary indifference to the commonest sanitary rules, there will be recurrences of them; indeed, it is more than probable that their number will increase rather than diminish. To show the utter stupidity of these local lights, an instance within the personal experience of the writer may be cited in which the only sanitary measure enforced in a case of typhoid fever was the fitting of a new spout to a kitchen sink. In a recent epidemic of over five hundred cases which were traced, beyond a shadow of doubt, to one milkman, it was found that the well from which the water to wash (?) his cans was drawn received the drainage of a number of cesspools and privy vaults. It is hardly credible that the milkman, who has gone scot-free, understood that the well-water was contaminated, but it is difficult to see how the danger of allowing even the existence of such a well, there being an abundant supply of water drawn from a distance, was not appreciated by those having the sanitary interests of the community in their hands. All that the average country health officer thinks of importance is to see that the water supply for the cows is fairly good and that the general surroundings are clean. These are, without doubt, proper subjects for investigation, but any inquiry into other matters is neglected. The greatest dif-

ficulty in the way of a proper investigation into the sources of the milk supply of a community lies in the fact that the health officers are, as a rule, poorly paid, and their tenure of office is very uncertain. Moreover, no matter how conscientious they may be, these officers, usually struggling practitioners, are insufficiently educated in sanitary science to know how to combat the conditions they have to oppose. The proper remedy would seem to lie in the appointment by the different States of competent officials, in a most rigid examination into the conditions existing in dairies, and in a system of licensing which would preclude those who have been detected in improper practices from selling milk. The law is assumed to regulate the traffic in liquor, and the question of a proper milk supply is nearly, if not quite, as important. Water may accidentally get into milk through carelessness in leaving a small amount after rinsing the cans, and if the water is potable it is of little moment, as the amount which could be introduced in that manner is extremely small. Ice is occasionally placed in the cans during warm weather, when the milk is shipped from a distance or can not be kept in a cool place, but practically its effects are hardly worth considering. In extremely cold weather, if milk is allowed to freeze, the portions first taken from the vessel in which it is will contain less water than that which is taken after it has melted. In some instances the last half of the contents of a forty-quart can which had been frozen has shown an increase of 40 per cent. of water.

Another point which is of nearly equal importance is the detection of cows affected with tuberculosis. There seems to be little question that the milk from them, even if tuberculous deposits do not exist in the udders, is unsafe to use; when they are found in that locality the danger is, of course, very greatly increased. It may also be said that the milk from such animals should not be given to swine or poultry, as they may become infected. In many of the States the killing of such animals is imperative, but there is no doubt that in many instances the disease is not suspected until it has become well marked. To protect the community, the law should insist upon the inspection of all cows, no matter if the milk from them is not sold, at stated intervals by competent veterinarians, and make it compulsory that in all cases the diseased animals should be slaughtered and every portion of the carcass completely destroyed by fire. Persons keeping cows for their own purposes should have them examined at least every six months. The milk from cows affected with the "foot-and-mouth disease" may give rise to an aphthous inflammation of the mouths of those using it.

Boric acid, salicylic acid, and sodium bicarbonate are sometimes added to milk in warm weather as preservatives. This use of them is highly objectionable, as they can not be employed in sufficient quantities to prevent putrefactive changes without rendering the milk unfit for consumption, and in small quantities they simply delay the souring process while allowing the decomposition which may lead to the formation of ptomaines. The detection of the two acids involves a good deal of chemical manipulation and considerable apparatus, and should be left to a chemist, but the presence of sodium bicarbonate in the ash is very easily detected by the addition of a small amount of acid, which causes effervescence, while it has not that effect on a normal ash. Salt, or sugar, or a mixture of both is sometimes added to watered milk to bring up its specific gravity, also "butter colour" to give it a good appearance. The detection of the sugar is rather unsatisfactory. It is accomplished with the aid of the polariscope, or by Trommer's test; an ash which exceeds 0·70 of the total solids usually indicates the addition of salt or sodium bicarbonate, the former of which should not overrun 14 per cent. of the ash; the "butter colour," consisting largely of annotto, is not of much importance by itself, and is not easy to detect except by an expert. Starch, calf's brains, and a variety of extraordinary substances are said to have been used in adulterating milk, but the tales relating to them are rather apocryphal. The term "condensed" should properly be limited to milks which are simply reduced in bulk by being deprived of water, and "preserved" to those similarly reduced, but containing in addition either cane sugar or milk sugar, and stored in hermetically sealed vessels. The first variety should contain about 50 per cent. of water, which represents a reduction to about one quarter of the original bulk; in the second about three quarters of the water is driven off, and sugar enough added to constitute about half the weight of the finished article. The condensed variety is rarely tampered with, except by using skimmed milk in its preparation, which is easily detected by ascertaining its specific gravity, calculating therefrom the amount of cream which the original milk should have contained, and comparing it with the amount found in the sample. With the exception of a few well-known brands, most of the preserved milk contains a smaller amount of butter or fat than it should, the fat having been removed prior to the condensing process, and often other fats are added to bring the milk up to the standard.

The ideal place in which to keep milk is an ice box, or refrigerator, from which everything except butter and eggs are excluded, as there are few articles of food which absorb all volatile bodies so readily as milk does. Where the conditions are favourable, a well-shaded building, preferably of stone or brick, in which there is a never-failing spring, is very satisfactory, the cans or vessels in which the milk is kept being partially submerged in the water and covered with netting to prevent frogs, etc., from jumping in. A deep well into which a pail can be lowered is by no means a bad place in which to keep small quantities of milk. Most commonly a country milk-room is in a cellar; and, provided it is light, cool, and well ventilated, this is free from objections, but as a rule it is difficult to find one of the proper

construction, etc. All vessels, no matter of what material they may be made, must be thoroughly washed with cold water after having been used until the water is free from all discoloration by milk, and then with boiling water, and, if possible, sunned for several hours. If hot water alone is used, it will be impossible to remove the last traces of milk, which will soon sour and taint the fresh milk almost as soon as it is placed in the vessel. As a rule, people are content to simply strain milk through the gauze with which all milk pails should be provided, but it is much better to employ a piece of fine, thin muslin, which must be washed each time it is used. At the present time, where a large amount of milk is handled the cream is separated by means of centrifugal machines, but, as they are expensive and require power to run them, their use is not widespread. and, moreover, the cream is too thick for any purposes except butter-making.

Where small numbers of cows are kept it is usual to place the milk in shallow pans, and to remove the cream at the end of ten or twelve hours, but from an economical standpoint this is a very wasteful method, for, especially in warm weather, separation is by no means complete before souring occurs, and the cream from sour milk is not so delicate as that from sweet milk, and is less suitable for table use; for butter-making it is as satisfactory, provided it is not kept too long. More perfect separation may be obtained by placing the milk fresh from the cow in tall cylinders which are placed in ice or cold water. Clotted or Devonshire cream is prepared by applying gentle heat to the pans, etc., in which milk has stood for twelve hours or so. As a rule, when cream is to be used for butter-making it should be collected for two or three days and then churned, as what is known as ripening—really a fermentative change—occurs, and without this the butter is apt to lack flavour and greater difficulty is experienced in churning. Cream varies in composition greatly according to the manner in which it is collected and the breed of cows from which it is obtained. The ordinary article of commerce contains about 15 per cent. of fat, while that obtained by the use of centrifugal machines may run up to four times that amount.

The question as to what is the proper amount of food for a milch cow is one that has been studied very closely and with considerable practical results. The standard which has been established in this manner allows 2½ lbs. of albuminoids and 13½ lbs. of non-albuminoids per diem for each 1,000 lbs. of live weight of the animal, or a sufficiency of food which contains about 1 part of carbon to 5 parts of nitrogen; but, as no one article contains these elements in the proper proportions, a mixed diet is necessary, and it is desirable also, because cows thrive better on it than when they are restricted to one kind of food. It is hardly within the limits of an article of this nature to give the various feeding tables in which the question is entered into very fully, and it is only necessary to indicate briefly the proper amounts of the commoner foods. During the months in which green pasture is not found a fair ration would be all the good hay and corn fodder, cut and cured when first in tassel, that will be eaten, and from 4 to 6 quarts of ground grain of any sort, or double that quantity of wheat bran, 2 or 3 quarts of carrots, potatoes, beets, or turnips, and a pint of rape or cotton-seed meal. Turnips must be used with caution, as they are apt to impart an unpleasant odour to the milk, which, however, can usually be removed by heating it to about 140° F., as may also the rank taste imparted by an alliaceous plant common in low grounds. Cotton-seed meal also needs care in its use, and not more than a large tablespoonful should be given in the beginning, as it is often not well digested until a sort of tolerance of it has been established. When it is assimilated properly there is nothing which can be used that will give so rich a colour to the milk and so increase the percentage of cream, but the butter made from it is apt to be oily. All roots must be cut into pieces sufficiently small to allow of their being swallowed unchewed, as cows often do this, and when the pieces are too large they may become impacted in the œsophagus. To obtain the very best results, it is necessary to cook the meal, and it is no detriment to do the same with the root part of the ration. During the coldest weather it is also desirable to raise the temperature of the drinking water to about 60° F., and it should hardly be necessary to state that salt should be at hand all the time. Fine bone meal is eaten greedily by most cows, and it is a desirable addition to the dietary of those with young calves.

Perhaps more important than the question of what a cow should eat is that of what she should not, as it is the common practice among dairymen to make use of a large number of articles entirely unfit for food. Formerly it was the custom to feed swill and house waste, but at the present time there is very little of this done, as the punishment for it is apt to be pretty severe, for the milk from cows fed on it is hardly fit to be given to pigs. It is difficult of digestion, and may give rise to all forms of gastro-intestinal disturbance; moreover, it rapidly becomes sour, and it is probable that the changes which give rise to the formation of poisonous ptomaines are set up more rapidly in it than in milk from properly fed animals. Unfortunately, it is very difficult to determine from the milk itself whether swill has been fed or not, unless inordinate amounts have been used, when there will be a decided odour of the swill in the milk. Distillery waste is open to the same objections as a food as swill is, and its use is almost universally prohibited. Brewers' grain, or exhausted malt, is very largely used by dairymen who live near breweries, and if only small quantities are used as an adjunct to other foods, and it is perfectly sweet, it is fairly unobjectionable. Usually, however, several hundred bushels are purchased at one time and dumped into pits where the grain rapidly becomes sour, but nevertheless is fed. By its use a large amount of milk is obtained, and the cow rapidly fattens, but she as rapidly

becomes diseased. The milk has an odour of grains and is usually pale, and the curd is tough, dense, and unfit for making butter or cheese or for condensing. Its use should be prohibited, but, as the revenue derived from the sale of grains constitutes a large portion of a brewer's profit, it is hardly possible to expect the passage of any prohibitory laws. When the grain is dried, before it has become sour, there is no objection to its use, but as yet no practicable method of doing this has been found. A number of the by-products of starch and glucose factories are used to a limited extent as cow food, but usually they have been dried and then are free from objection. Ensilage is used to a considerable extent, and seems to be without any harmful influence upon the milk, but the belief that it shortens a cow's life is entertained by a good many persons. During the season when green food is abundant it is not the custom to supply anything in the shape of grain, but it is a great mistake, as one pound of corn meal will increase the amount and richness of the milk far in excess of its money value. Pastures should, if possible, be provided with shade and an abundant supply of running water, and should not be too far from the milking place, where there should be an open shed under which the cows may go at night in case of rain, etc. As soon as the first heavy frosts have chilled the herbage it is best to put the cows into their winter quarters and keep them there until the frost is entirely out of the ground. All buildings used during the winter must be well lighted and ventilated, and cleaned out at least twice a day. Where pasturage is not abundant it is often customary to keep cows in confinement during the entire year, supplying them with green food during its season. Provided cleanliness, etc., are observed, nearly as good results are obtained as when the cows are allowed free range.

[In the *Report of the Dairy Commissioner of the State of New Jersey for the Year 1894* Professor Albert R. Leeds gives some interesting data as to the milk of different breeds of cows. He says:

"The Holsteins give the lowest solids, then the Holderness, Ayrshire, Devon, Guernsey, and highest, the Jerseys. The order for fat is Holsteins, the lowest, then Holderness, Ayrshire, Devon, Guernsey, and Jerseys. But in total production of milk, the Holsteins lead, with a daily yield of 22·65 pounds, Ayrshire next, then Guernsey, Jersey, Holderness, and the Devons the lowest, with 12·65 pounds.

"In the course of inspection the question of breed frequently comes up and demands the most serious consideration. In the month of April of this year the milk of one of the largest and best-appointed dairies in this State was condemned by the inspectors in the city of New York, to which place it is exclusively shipped, and the dealers were fined. The dairyman thought some serious blunder must have been committed, or that he had been grievously wronged. He had two samples, representing the whole milk of his dairy, analyzed by responsible chemists in New York. They reported that the milk was certainly much below standard. . . .

"Still more astonished at these results, the proprietor of the dairy brought to me two more samples, representing as nearly as possible similar milk to that examined in New York, with the request that I should check the New York results by independent analyses." The samples were analyzed with substantially the results found in New York.

"In order to satisfy myself by personal inspection," Professor Leeds continues, "I visited this dairy, where every detail of feeding, care, and the history and condition of the cattle was explained in full. I found the water excellent, and so also the arrangements for cooling and handling the milk. The cows were in admirable condition, and their stabling and keeping as they should be. They were mainly thoroughbred registered Holsteins. The analyses above reported are of milk which was stated to be the whole mixed milk of six of these thoroughbred Holsteins in an average condition as to freshness. Their feeding was as follows, April, 1894:

"5 A. M.—Hay.
"6 A. M.—Four quarts mixed feed; milking.
"7.30 A. M.—Hay.
"9 A. M.—Turned into field till—
"4.30 P. M.—Cornstalks and hay.
"5 P. M.—Four quarts feed; milking.
"6 P. M.—Hay.

"The feed was made up of four tons of ground yellow shelled corn, two tons of middlings, and two tons of bran. I examined samples of these separate materials in the laboratory and found them to be of good quality.

"In order to arrive at the nature and extent of the variations in the quantity and composition of these thoroughbred Holstein cattle under the same conditions of feed and keep, but under different conditions as to freshness, I had the total milk of a Holstein, due in the course of about nine weeks, drawn into one pail, and the total milk of another Holstein, which had calved a month previously, drawn into another. The first yielded only a quart and a half. It was stated to be giving about two quarts and a half at the morning milking, or a total of four quarts per diem, and at the time of my visit was the lightest milker in the herd.

"The composition of this one quart and a half of night's milk was:

"SMALLEST MILKER.

	Per cent.
"Fat	5·00
"Albuminoids	3·48
"Milk sugar	4·23
"Ash	0·71
	13·42

"The heaviest milker, the one which had recently calved, yielded nine quarts in the evening, of which a portion was taken and analyzed as below, and eleven quarts in the morning, or twenty quarts in all.

"LARGEST MILKER.

	Per cent.
"Fat	2·80
"Albuminoids	2·70
"Milk sugar	4·16
"Ash	0·58
	10·24

"Taking 12 per cent. as the standard for total solids and 3·5 per cent. for fat, there were, then, in the same herd, fed on the same rations, at one extreme a cow whose milk exceeded the standards of solids and fat by 1·42 per cent. and 1·50 per cent., and at the other extreme a cow whose milk fell below these standards by 1·76 per cent. and 0·70 per cent.

"On obtaining these results, the gentleman owning the dairy changed the make-up of the herd by the addition of a sufficient number of Jersey cattle to insure the percentage of total solids and fat always going above the State requirements."

Professor Leeds earnestly insists that nothing stated by him should be construed as indicating a belief in the inferiority of Holsteins as milch cattle. On the contrary, he says, they are invaluable. The milk obtained by mixing the product from Holsteins with that of breeds giving richer milk he believes to be better adapted to keep and transport in good condition; to obtain a fair compensation from, and better for the general uses of milk (including that of feeding children), than the richer milk obtained from Jersey cattle alone. The drawback that its larger volume is accompanied by a low percentage of solids is in practice readily overcome by mixing. This also, says Professor Leeds, is the right way of solving the commercial and legal aspects of the matter.]—RUSSELL H. NEVINS.

MINERAL WATERS. — See WATERS, MINERAL.

MINT.—See MENTHA PIPERITA and MENTHA VIRIDIS.

MISTLETOE.—See VISCUM ALBUM.

MIXTURES, the *misturæ* or *mixturæ* of the pharmacopœias, are properly liquid preparations containing suspended insoluble substances, but the term, as commonly used, embraces those made up of two or more liquids. They usually contain some gummy or viscid substance to assist the suspension of the insoluble ingredient.

MOLLIN.—This is a variety of soft soap, containing an excess of fat, that has been employed as a basis for ointments. It is bland and readily washed off from the skin.

MOMORDICA.—See ELATERIUM.

MONOBROMACETANILIDE.—See ANTISEPSIN.

MONOCHLORACETIC ACID. — See under CHLORACETIC ACID.

MONOCHLOROPHENOL. — See under CHLOROPHENOLS.

MORPHINE.—See under OPIUM.

MORRHUOL.—This is a substance containing iodine, sulphur, and phosphorus prepared by Chapoteaut from cod-liver oil, and considered by him to represent the active constituents of the oil. It is a bitter, acrid liquid, of a disagreeable odour. It has been used as a substitute for cod-liver oil in daily amounts of from 12 to 30 grains in capsules containing 3 grains each.

MORUS.—See MULBERRY.

MOSCHUS.—See MUSK.

MOSS, ICELAND.—See CETRARIA.

MOSS, IRISH.—See CHONDRUS.

MOTOR DEPRESSANTS, in the widest sense, include all agents which impair the motor powers of the body by depressing any part of its motor apparatus. The term is usually applied to the drugs which directly depress the motor activity of the spinal cord, but this application is too restricted to be accurate, as it would exclude many of the most powerful and useful motor depressants. Drugs which depress the cerebral motor convolutions, the motor centres in the medulla, the motor nerve-trunks and nerve-endings, or the muscular contractility itself, produce impairment of the motor power, and in large doses may cause complete motor paralysis of the part or parts involved; but those which affect the involuntary muscular tissue and its nervous apparatus are not usually comprised in this category. The *cerebral motor convolutions* are powerfully depressed and finally paralyzed by large doses of alcohol, ether, and chloroform, which completely arrest all voluntary movements; also to a lesser degree by cold, chloral, bromides, and large doses of atropine. The *medullary motor centres* are powerfully depressed by large doses of alcohol, ether, and chloroform, also by aconite, opium, chloral, conium, physostigma, etc., death from poisoning by these drugs usually occurring in this way. The *anterior cornua of the spinal cord* are directly depressed by physostigma, carbolic acid, and many less powerful drugs, thereby producing paralysis of the limbs; and indirectly by agents which reduce the spinal circulation, such as digitalis, aconite, and large doses of quinine. The *motor nerves* are depressed by conium, methyl-strychnine, etc., producing the same result. The *motor nerve-endings* are remarkably depressed by curare, even in small doses, also by the compound ammonias, by methyl compounds, and by belladonna, the latter affecting chiefly those in the involuntary muscles. The *muscular tissue* itself is directly depressed by lead and potassium salts, by apomorphine and many other emetic drugs, by digitalis, quinine, chloroform, large doses of alcohol, etc., and slightly by curare; also by galvanism locally applied, the latter being the means in ordinary use for reducing muscular activity directly. *Co-ordination of motion*, governed by the cerebellum, is peculiarly impaired by certain drugs, notably alcohol, which in full doses produces a staggering gait, disturbance of the ocular muscles with double vision, thickness of speech, and awkwardness of manual movements. Apomorphine in large

doses causes the animal to move round and round in a circle.

A complete list of the motor depressants would include many drugs which, except in this particular action, have but little in common with each other. The most important are the five following named:

Curare.—The injection of even a small quantity of curare subcutaneously into one of the lower animals causes general muscular paralysis, the only muscle escaping being the heart. By a full dose the paralysis is rendered so complete that the animal lies apparently dead, but its heart beats, a divided artery spurts, and it may be kept alive indefinitely if artificial respiration is maintained. Bernard showed that the action of the drug was not upon the muscles themselves, though it slightly impairs their contractility, or upon the motor nerve-trunks, or the spinal tracts, or the sensory nerves, but that it was limited to the motor nerve-endings in the muscles; and Politzer holds that the exact locality of the part acted upon is the nerve fibril before it has quite lost its medullary sheath, and that the poison destroys the conducting power of the nerve by acting on the cement substance at Ranvier's nodes. Curare is also a powerful depressant of the respiratory centre in the medulla.

Physostigma in a large dose, given to one of the lower animals, causes general muscular tremor at once, the animal soon falling to the ground in a state of complete muscular flaccidity, with complete abolition of reflex action, the tremors continuing during the entire period of muscular paralysis. The action of the drug is due to its alkaloid physostigmine (eserine), which is a direct depressant of the spinal cord, particularly of the ganglion cells of the anterior cornua, exactly opposing the action of strychnine thereon; and is not that of a depressant of the cerebrum, the nerves, or the muscles, but, on the contrary, stimulates muscular fibre, both voluntary and involuntary, throughout the body, and seems to increase the excitability of the cortical motor centres. Calabarine, the second alkaloid, has an antagonistic action to that of physostigmine, and different or even contradictory results are obtained from physostigma according to the proportion of each alkaloid present in the preparation employed.

Conium was the state poison of the Athenians, its motor paralysant power being well known to the ancients. Socrates was poisoned by the "hemlock-cup." Its marked motor depressant action is due to the alkaloid coniine, the influence of which is expended on the entire course of the motor nerves, the nerve-endings in the muscles being most affected. In poisoning by conium, convulsions are not infrequent, being due to the second alkaloid, methyl-coniine, which stimulates the spinal cord, the two alkaloids having a close resemblance in action to physostigmine and calabarine.

Gelsemium depresses the sensory columns of the spinal cord as well as the motor centres in the cord and medulla, and also has a direct depressant action on peripheral nerve structure. Its production of double vision is due to its paralysis of the sixth nerve, which supplies the external rectus muscle of the eye; its production of ptosis, dilatation of the pupils, and paralysis of accommodation, to its action on the terminal ends of the third nerve. It has a paralyzing action also on the hypoglossal, causing glossoplegia, and on the branches of the fifth nerve supplying the elevator muscles of the lower jaw, producing drooping thereof. It also depresses the sensory terminations of the fifth nerve, especially those of the branches going to the lower jaw. The general motor-depressant action of gelsemium is more easily induced in the lower animals than in man, being present in the latter in marked degree only from overdoses, though local palsies are often observed from medium doses. Death occurs from asphyxia due to paralysis of the muscles of respiration.

Potassium bromide has a more extensive range as a motor depressant than any of the above-named drugs, affecting the cerebral motor convolutions, the afferent nerves, and the muscular tissue, as well as the spinal cord. Its action, however, is slow, and requires the continuous administration of the drug in full doses for some days to be developed decidedly. The peripheral terminations of the motor nerves are more strongly depressed by it than the nerves themselves in any part of their course. It affects the nervous system with proportional severity, as expressed in the following order: (1) spinal cord, (2) cerebral motor convolutions, (3) motor nerves, (4) medullary motor centres. Its depressant action on the spinal reflex centres is constantly employed in the treatment of the convulsive disorders of children; and its great usefulness in epilepsy is due to its action on the cerebral motor convolutions, and not to its influence on the cord. When pushed to complete saturation of the system it involves also the special senses, and produces profound depression of the mind and complete prostration of the muscular tissue throughout the body.

Besides the drugs already mentioned, the following-named agents possess more or less positive motor-depressant action, viz.:

Opium, morphine.	Hydrobromic acid.
Apomorphine.	Carbolic acid.
Aconite.	Potassium salts.
Veratrum.	Sodium salts.
Pulsatilla.	Lithium salts.
Tobacco.	Copper salts.
Lobelia.	Zinc salts.
Grindelia.	Lead.
Phytolacca.	Mercury.
Quebracho.	Arsenic.
Muscarine.	Antimony.
Pilocarpus.	Emetine.
Camphor.	Hydrocyanic acid.
Ergot (at last).	Potassium cyanide.
Arnica.	Ammonium cyanide.
Ailanthus.	Ammonium iodide.
Saponine.	Many compound ammonias.
Sparteine.	Turpentine.
Belladonna, atropine.	Amyl nitrite.
Stramonium.	Sodium nitrite.
Hyoscyamus.	Nitroglycerin.
Alcohol.	Amyl valerianate.
Ether.	Methyl-strychnine.
Chloroform.	Many methyl compounds.
Chloral hydrate.	Ptomaines.
Bromal hydrate.	Galvanism.
Bromides.	Cold.

SAMUEL O. L. POTTER.

MOUSSENA.—The bark of this Abyssinian tree, *Albizzia* (or *Acacia*) *anthelminthica*, has been employed as a remedy for *tapeworm.* The powder is given in doses of a drachm. An alkaloid found in it, *moussenine*, may be given in doses of from 3 to 4 grains.

MOVEMENT CURE.—See under Exercise, page 413.

MUCILAGES.—See Demulcents.

MUCUNA, *cowhage*, consisting of the pod-hairs of *Mucuna pruriens*, was formerly official and was used as an *anthelminthic*, especially against *lumbrici*, which the hairs were supposed to kill by penetrating them mechanically. They were swallowed in the form of a linctus.

MULBERRY.—Mulberry-juice, *mori succus* (Br. Ph.), is the juice of the ripe fruit of *Morus nigra.* Syrup of mulberries, *syrupus mori* (Br. Ph.), is slightly *laxative* in doses of a fl. drachm, but is mostly used as a flavour.

MULLEIN.—See Verbascum.

MURIATIC ACID.—See Hydrochloric acid.

MURIATIC ETHER.—See Ethyl chloride.

MUSCALE BUTTONS. — See Anhalonium Lewinii.

MUSCARINE is a highly poisonous alkaloid found in the fungus known as *Agaricus muscarius*, formed by the oxidation of choline and having the formula

$$(CH_3)_3 \equiv N{<}^{CH_2 - CH{<}^{O}\left(\begin{smallmatrix}H\\ OH\end{smallmatrix}\right)}_{OH}.$$

Poisoning with muscarine, commonly encountered in the form of *mushroom poisoning*, is characterized by intense vomiting and purging, with salivation, loss of muscular contractility, and contraction of the pupils. It is to be treated with atropine, which is the physiological antagonist of muscarine. The nitrate and the sulphate of muscarine have in their turn been used as antagonists in cases of *belladonna poisoning.* The amount that may be given daily is said to be from 0·015 to 0·308 of a grain. According to Dr. Cerna, it has been employed with apparent success in the treatment of *diabetes insipidus.* Experience with its use as a remedy is still so small as to call for the greatest caution in its administration.

MUSK, *moschus* (U. S. Ph., Br. Ph., Ger. Ph.), is the dried secretion obtained from the preputial follicles of *Moschus moschiferus*, or the musk deer, which inhabits the mountainous regions of southern and eastern Asia. The musk is contained in a sac which—necessarily in the male animal only—lies between the umbilicus and the prepuce. This bag is from two to three inches long, and opens by a small orifice surrounded by hair at its anterior part. Posteriorly, a furrow represents the opening of the prepuce. The musk is excreted by the animal through the anterior orifice, and is, according to Pallas (Desmoulins, *Dict. class. d'hist. nat.*), in some way connected with the act of reproduction. Darwin (*Descent of Man*, New York, D. Appleton & Co., 1890) expresses his belief that this odoriferous secretion of the musk deer has to do with sexual selection, but admits that the fact that the musk is not increased during the rutting season seems inexplicable from this view.

In the market musk is found in sacs, supposed to be original, and is of two varieties, the Russian or Siberian and the Chinese, Thibetan, or Tonquin. The former is said never to be adulterated; the latter is believed to be uniformly degraded. Pure, it should be soft, unctuous, of a reddish-brown colour, in grains or lumps. It is soluble in the proportion of 10 per cent. in alcohol and of 50 per cent. in water. It has a heavy, penetrating odour. One part of musk will cause 3,000 parts of inodorous powder to smell. A whiff of pure musk has caused nausea, headache, and even convulsions. In taste it is bitter and astringent.

The Germans recognise the test of Bernatzik (quoted in the *Am. Jour. of Pharm.*, 1861) for pure musk. A small quantity of musk is kept in a thin layer under oil of turpentine and examined microscopically. It should show brown, diaphanous, amorphous splinters and lumps, free from foreign substances.

Musk was unknown to the ancients as a medicine. It was first introduced into Europe by the Arabians, and has been used largely since then for medicinal purposes. It is a *stimulant* and *antispasmodic*, and has been particularly recommended in ataxic phenomena arising in the course of an acute illness. In *typhoidal diseases*, when there are subsultus tendinum, mild muttering delirium, and hiccough, and when coma or collapse is absent, musk has been regarded as valuable. Trousseau's classical recommendation of the drug in the *adynamic pneumonia* of drunkards with cerebral symptoms has produced a wide use of it in this and similar conditions. In reverse conditions musk is said to produce refreshing sleep, to allay muscular spasm, and to favour perspiration, at the same time rendering a rapid, small, irregular pulse less frequent, fuller, and more regular.

In such spasmodic affections as *hiccough*, *laryngismus stridulus*, *spasmodic cough*, and *pertussis* it would naturally have advocates. Success has been alleged for it in the treatment of *chorea*, *tetanus*, and *hysterical convulsions.* In cases of *insomnia* which is due to bodily and mental fatigue, as in *delirium* of some hours' duration, musk is said to have produced calm sleep. The drug seems to have a powerful effect on the respiratory centre, and has been recommended against threatened *paralysis of respiration*, especially when there is an exudate upon the meningeal surface, as in the advanced stages of *cholera infantum* or *meningitis* of the cerebral type.

In the form of an ointment or a plaster musk has been employed in *muscular rheumatism* and *arthritic pain* following a sprain or an acute or chronic joint disease. Its anodyne effect is very slight, however.

Musk is best administered, in the form of pill or emulsion, in a dose of from 10 to 15

grains. It may be given by enema, suspended in mucilage, or in a suppository. There is a tincture, *tinctura moschi* (U. S. Ph., Ger. Ph.), of which the dose is from 1 to 2 fl. drachms.

An interesting contribution to the therapeutics of musk, especially since the drug is now little used, is to be found in the *Philosophical Transactions of the Royal Society* (London, vol. from 1744 to 1749, p. 206). Dr. Parsons narrates a case "of rheumatic fever, attended with loss of the use of his limbs, excessive pain in every part, and swellings in his knees and hands, with all the other symptoms usual in this kind of fever." The patient was as stubborn as some modern patients, and discharged his apothecary and two physicians in turn, refusing their offers to bleed and their medication. Finally, on the twenty-third day of his disease, Dr. Parsons "found him most miserably afflicted with 2 of the most dangerous symptoms that can appear at the end of such a dangerous distemper—viz., a long intermission of his pulse every 3d or 4th stroke and a most fatiguing hickup which struck him violently about 10 times a minute. He was given 105 grains of musk in 30 hours and made a splendid recovery."

It is possible that the fear of an overdose has prevented the more liberal use of the drug in modern practice, but its high cost and the likelihood of its adulteration are factors which interfere with its more general application.

Samuel M. Brickner.

MUSK ROOT.—See Sumbul.

MUSSANA, MUSSANINE, MUSSENA, MUSSENINE.—See Moussena.

MUSTARD is the sifted farina made from the mixed seeds of the black and white mustard plants. It should be of a bright-yellow colour and be easily compressed into a coherent mass. In the U. S. and Br. Ph's the unground seeds of the white and black mustard are known respectively as *sinapis alba* and *sinapis nigra*. The German mustard, *semen sinapis* (Ger. Ph.), is black mustard. Commercial mustard is identical with the *sinapis* of the Br. Ph., and different samples vary in pungency according to the proportion of the black mustard they contain, for that is much stronger than the white on account of the presence of a volatile oil, *oleum sinapis volatile* (U. S. Ph.), *oleum sinapis* (Br. Ph., Ger. Ph.), which is lacking in the white variety. This oil does not exist in the free state, but is developed by the reaction upon each other in the presence of water, of sinigrin (potassium myronate), and myrosin; to produce this, the water should never be very hot, as reaction does not take place except at moderate temperatures, nor in the presence of vinegar. To this oil are due the rubefacient properties of black mustard, while in the white variety sulphocyanate of acrinyl, a body developed by the action of myrosin upon sinalbin under the same conditions as in the case of the volatile oil, takes its place. The cheaper grades of table mustard often consist almost exclusively of the white variety, or may be simply flour or starch coloured with turmeric, etc., and given a pungent taste by capsicum. French and other prepared mustards are the ordinary variety diluted with flour, etc., or combined with vinegar. Black mustard is less active when alone than when mixed with a small proportion of the white, as it seems to contain insufficient myrosin to develop its full activity, while in the white there appears to be an overplus.

As a condiment, mustard is extensively employed. It stimulates the appetite to a certain extent, but appears to act as an irritant to the stomach and to increase the secretion of the gastric juice but little. It is probable that in the various prepared mustards, or those combined with vinegar and other condiments, the action of the mustard is very limited, and that their use is without any serious drawbacks; but, unmixed, it should be used sparingly.

From both varieties a bland oil is obtained by expression, which is used in various parts of the world as a food, to make soap from, and as an illuminant. The seeds are also used, particularly as a household remedy, in the treatment of *dyspepsia* accompanied by constipation, and as a *laxative*, a tablespoonful, preferably of the white variety, being taken in molasses or any other convenient vehicle two or three times a day. It is probable that the results obtained from this employment of mustard are due to its mechanical effect rather than to any specific substances derived from it under the influence of the fluids of the alimentary canal.

As a *rubefacient* and *counter-irritant*, mustard is more largely employed than any other substance, as well on account of its efficiency as because of the facility with which a fairly pure sample can be found. It is rather more painful than other rubefacients, and its effects must be carefully observed, for, if it is allowed to remain on for too long a time, ulceration, which is slow in healing, is apt to follow, and in many cases gangrene has been known to occur. This property renders its use to arouse alcoholics and those insensible from other causes and upon paralyzed parts open to objections unless great care is taken. For the purpose of counter-irritation a mustard plaster or poultice is oftener used than any other agent, and it probably is more useful. In its preparation only tepid water should be employed, for the reasons already given. Without the admixture of some inert substance, such as flour, bread, linseed meal, or the like, its action is entirely too vigorous, except in cases where a very profound and speedy effect is desired. As a rule, unless the person to whom a mustard poultice is to be applied is known to have a skin which is not easily irritated, or the case is one where a decided effect is sought for, not more than 1 part of mustard to 5 parts of flour should be used; if this strength is not sufficient it is easy to increase it until the proper point is reached. It will be rare, however, that the mustard should be equal in bulk to that of its diluent. For children, it is wise to use a mixture of 1 part of glycerin and 2 parts of water, rather than simple water, as the action of the mustard is lessened somewhat and

the plaster may be kept in position for a longer period. The consistence of the paste should be such as to allow of its being spread evenly and yet such that it will not run. It should be placed between layers of muslin, the number of thicknesses of which must be determined by the demands of the case and the sensibility of the patient's skin, and allowed to remain for a period not exceeding half an hour, the hair of the surface to which it is to be applied being shaved off, and it is rare that the proper amount of irritation is not set up in a shorter time. After the removal of the plaster, if the smarting and pain are annoying, the surface should be sponged with warm water or ether, dusted with starch or flour, and covered with cotton to exclude the air. Ordinarily the pain is momentarily increased by these measures, but relief speedily follows. The official mustard poultice, *cataplasma sinapis* (Br. Ph.), contains equal parts of mustard and linseed meal. It presents no advantages over that prepared extemporaneously.

Mustard paper, *charta sinapis* (U. S. Ph., Br. Ph.), is a very convenient substitute for the ordinary poultice, and is especially useful for travellers, as all that is required is to wet it with tepid water and apply it to the surface with or without a layer or two of muslin interposed; few are able to endure the pain without at least one layer. Mustard paper is, when fresh, much stronger than the poultice, and should be used only in emergencies or under conditions where no conveniences for making the poultice are at hand. The unofficial capsicum plasters are just as easily obtained, and are in nearly all cases as efficient.

The volatile oil is very offensive, yielding vapour irritating to the mucous membranes, and is strongly rubefacient, but its action is not easily controlled unless it has been diluted with some inert substances. It is sometimes combined with 10 parts of glycerin and sufficient starch to form a paste, which is applicable under the same conditions as the ordinary plaster. By combining 1 part of glacial acetic acid, 3 parts of the oil, and 18 parts of collodion a preparation is obtained which is readily applied, but the action of which must be watched carefully lest it should be too energetic. Compound liniment of mustard, *linimentum sinapis compositum* (U. S. Ph., Br. Ph.), has this oil as a basis, and contains in addition mezereum and camphor. It is highly irritant. It is adapted to the ordinary uses of a stimulating liniment, but, if applied in sufficient quantities, will act as a rubefacient, especially if the parts are covered with cloth, flannel, etc. By dissolving 1 part of the oil in 15 parts of alcohol or any bland oil a somewhat mild liniment may be made.

Mustard plasters are particularly applicable for the relief of *pain*, as in all forms of *neuralgia*, and will often be all that is needed to effect a cure in mild attacks of *diarrhœa*, being in these cases applied over the abdomen. In *bronchitis*, either when the condition is that termed a severe cold or when the fever is marked and the pain in the chest severe, they act remarkably well. In the first instance the plaster need be only of sufficient size to cover the surface overlying the spot of soreness in the chest which usually exists, but in the latter it should be sufficiently large, especially in children, to cover the lateral surface of the side over the affected lung (both sides if both lungs are involved). Cloths of suitable dimensions should be fitted with tapes or strings in such manner that they can be readily held in place without moving and coated with the mustard, which must be diluted sufficiently to allow of the plaster's being kept in place for an hour or two, as the design is to create a diffuse moderate reddening of the surface.

Nausea is often relieved by a mustard plaster over the stomach, and one over the hepatic region will sometimes assist other measures which may be adopted in the treatment of an attack of *migraine*. *Headache* due to indigestion, or in fact any variety, unless a symptom of grave intracranial disturbances, will usually be relieved, if not entirely dissipated, by hot pediluvia into which mustard, previously mixed with cold water and allowed to stand for a few moments, is introduced.

In this connection it is well to remember that, when once formed, the oil of mustard is volatilized to some extent by hot water, and that care should be taken that the vapour arising from the water does not come in contact with the eyes. Pediluvia, general baths, or sitz-baths prepared with mustard are very popular measures to promote menstruation and are usually successful except when the *amenorrhœa* is not purely functional. General baths are useful often in redeveloping the rash of the various *eruptive fevers* when recession has occurred. It is impossible to lay down any fixed rule for the amount of mustard to a gallon of water which is proper to be used, as its quality varies greatly according to the maker and also according to the time a sample has been exposed to the air, but it is well not to start with more than a teaspoonful, as it is easy to add to it if tingling and reddening of the skin do not seem to come on quickly enough.

When an *emetic* is called for in an emergency nothing is usually so handy as mustard, two or three teaspoonfuls of which may be given, mixed with a tumblerful of water. This usually acts promptly and is not followed by depression.

[Spirit of mustard, *spiritus sinapis* (Ger. Ph.), is a solution of 1 part of volatile oil of mustard in 49 parts of alcohol. It may be used as a mild irritant.

In the *Medical News* for December 22, 1894, Dr. Roswell Park says that it has long been known to surgeons that mustard is an efficient *deodorizer*, and that among chemists it has long been well known that the essential oil of mustard is a powerful *antiseptic*. In fact, he says, among some it has been classed as the most powerful of all. For years, says Dr. Park, it had been his custom in teaching anatomy to use mustard as a deodorant upon the hands after working with anatomical material. After considerable use of it in this way he came to feel such confidence in it that he did not hesitate to go at once from the dead

room or from a post-mortem examination to operate upon living patients after having disinfected his hands thoroughly with mustard. For several years, he says, it had been his custom to thus resort to mustard, until the vagaries of surgical fashion led him to discontinue it and to disinfect his hands with potassium permanganate, sulphurous acid, or other more unpleasant or irritating materials, of which he soon got tired, and from which his hands used to suffer more or less.

A year or more before the date of his writing, Dr. Park says, he was enabled to subject the mustard again to such a rigid test that it seemed to him sufficient to give it the highest place in professional confidence. He had under his care two patients with diphtheria, upon both of whom he operated and from one of whom he contracted the disease. Both died, and on the day before he became sick he went to the house to withdraw the intubation tube that had been inserted the day before. The case had been malignant in its clinical aspects, and the mouth and pharynx were filled with horribly offensive material. Prying apart the jaws, he succeeded in removing the tube and then proceeded to disinfect his finger, as he was obliged to visit at once another patient on whom he was to operate for varicocele.

He spent twenty minutes or more with hydrogen dioxide and with alcohol, endeavouring to disinfect his hands, particularly the left index finger. But the odour still clung to it, and he would not trust it for any operative work, especially about the veins. Upon his arrival at the patient's house, he continues, he called for some ordinary flour of mustard, and, while washing his hands for the operation, spent some ten or fifteen minutes in rubbing this mustard, made into a paste, into all the crevices and cracks about his hands and finger nails. All odour, he says, was at once removed; he then proceeded with the operation and never had a more satisfactory result. The next day he was taken sick, showing that there had been about him the germs of the disease, but that they had not clung to his hands. This, Dr. Park says, restored all his early confidence and liking for mustard as an antiseptic, and since that time he has used it to the exclusion of everything else, both in his hospital and in private work.

Dr. Park thinks that the range of applicability of flour of mustard as found in the kitchen of every household is very large. The physician, he says, is often called upon to get his hands into material which is offensive and malodorous, and the expedients to which he resorts in order to rid himself of the odour are many. After making post-mortem examinations, after removing decomposing placental masses, and cleaning out the uterus in cases of abortion, after opening various deep and fœtid abscesses, after handling gangrenous cases, there is nothing, Dr. Park says, so readily at hand and so effectual as mustard.

In the *Medical Record* for March 17, 1894, Dr. Charles E. Simon, of Baltimore, relates a case of poisoning with mustard, and cites a statement of Kobert's to the effect that *mustard poisoning* is by no means rare. Dr. Simon's patient was a German girl, twenty-seven years old, who, having missed a menstrual period after illicit sexual intercourse, supposed herself pregnant, and, in order to end her life, swallowed a cupful of mustard flour made into a thin paste with vinegar. The greater part of this was vomited immediately.

When Dr. Simon first saw the patient, a few hours later, vomiting had been almost incessant, and continued throughout the greater part of the day (January 16th) and the morning of the 17th. On examination of the vomited material, this was at first found to consist of some remnants of food, with much mucus, and containing some bile, but no blood; the reaction was acid, but free hydrochloric acid could not be demonstrated with either Günzburg's or Boas's reagent. The material which was subsequently brought up, after much distressing retching, was of a bright-green colour due to the presence of biliverdin, and was devoid of blood and hydrochloric acid, its reaction being neutral.

Shortly after the first attack of vomiting diarrhœa set in; the stools at first were fæcal in character, but a few hours later they consisted of pure blood. There were between twenty and thirty during the first twelve hours. There was no tenesmus.

At the time when Dr. Simon first saw the patient she complained of agonizing pain, confined to the upper abdominal zone, extending into the back, and most severe in the epigastric and upper umbilical regions. The most careful and delicate attempts at palpation in these areas caused excruciating pains. Pressure in the lower zone, however, was well borne and caused no distress. The tongue presented a normal appearance.

The mind was clear; there were no twitchings or tremor; the pupils were of normal size; the pulse was 92 and small; the respiration was shallow, varying between 50 and 60; the temperature was 97·8° F.; the face was pinched and the forehead covered with beads of perspiration; and the patient was lying on her back with the legs extended. From time to time, Dr. Simon says, the patient would rise in bed to relieve the excessive pain in her back. There was great thirst.

The patient, although closely questioned, denied having taken any drug, and that she had not felt well for several days, having suffered with "diarrhœa and indigestion"; later in the day, however, the history already given was obtained.

Turpentine stupes, linseed tea, and small amounts of iced Apollinaris water were ordered; morphine was given hypodermically in full doses; white of egg, even in teaspoonful doses, was immediately vomited, and hence no nourishment was given during the first twenty-four hours. The severe abdominal pain continued and the passages became bloody; the vomiting ceased after midday. The whites of fourteen eggs were given in the course of the day, and retained, and enemata of from 20 to 30 drops of laudanum in starch were given every four hours, but were retained only from

ten to fifteen minutes. The whole abdomen was excessively tender. At 11 A. M. the temperature was 96·8°; at 5 P. M. it was 97·2°. On the morning of the 18th it was noted that the girl had had a better night, and she continued to improve so that at the end of ten days from the time of her taking the mustard she was able to resume her work as a cook. Abortion had not then taken place, but it did occur on Feb. 24th, the forty-seventh day—evidently, as Dr. Simon suggests, without any connection with the mustard poisoning.

During the illness the most prominent features of the urine had been a very pronounced scantiness, a slight degree of albuminuria, and an enormous increase in the amount of uric acid and indican. A few hyaline casts and a slight increase in the number of leucocytes were observed during the first two days. From the 18th on, a slight increase in the uric acid and indican persisted for almost a week, when the urine resumed its normal character. Following the ingestion of mustard in the human being in large amounts, says Dr. Simon, a most severe action affecting the gastro-intestinal mucous membrane takes place, due to the presence of the two mustard oils set free, the common mustard flour of the household consisting of both black and white mustard; this action manifests itself in vomiting, salivation, severe enteralgia, colic, diarrhœa, contractions of the uterus, leading at times to abortion, albuminuria, and even hæmaturia, dyspnœa, œdema of the lungs, convulsions, a pronounced depression of the temperature, central paralysis, and even death. Post-mortem, inflammatory anatomical alterations are found at the places of contact, as also multiple hæmorrhages. The urine is said to emit the odour of mustard, a point which, Dr. Simon says, he has been able to observe in his case; a similar odour is said to be observed in the cadaver. A reducing substance is also mentioned as occurring in the urine, but Dr. Simon has not yet been able to demonstrate it.]—RUSSELL H. NEVINS.

MUTTON SUET.—See SUET.

MYDRIATICS.—The term mydriatic has been applied from very early times to any agent which produces dilatation of the pupil. At present there are several known to act in this manner, nearly all being obtained from plants which belong to the *Solanaceæ*.

Atropine, which is obtained from *Atropa Belladonna*, is extracted in the presence of an alkali, usually soda or potash, and has no polarizing power. In this it differs from hyoscyamine, with which atropine is often confounded. Jaarsma has found that a drop of a solution of 1 part to 80,000 of water is sufficient to produce a well-defined effect in enlarging the pupil. If a rather strong solution of atropine is used—for example, 1 to 120—in about eight to twenty minutes after the instillation its effect is perceptible. The pupil begins to increase slowly in size for about fifteen minutes, then for about ten minutes it dilates rapidly, reaching its maximum limit, and remains at that point until about the end of the third day. Then it begins, slowly and regularly, to return to its original size. This is not reached until about the end of the fourteenth day.

Homatropine is obtained by the action of hydrochloric acid on the cyanate of atropine. It is usually found under the form of the hydrobromide of homatropine, which is a crystallizable salt producing effects similar to that of atropine, but not so lasting. Moreover, homatropine is said not to increase the intra-ocular tension—also an advantage which will be referred to further on. It does, however, produce some irritation of the conjunctiva, and is therefore not well adapted to protracted use.

Hyoscyamine is obtained from *Hyoscyamus niger*, but it can also be obtained from *Atropa Belladonna* if extracted in a manner entirely similar to that in which atropine is extracted, except that it is not done in the presence of an alkali. We shall see further on that the actions of these two, atropine and hyoscyamine, differ in many respects, though it is probable that much of the atropine used is indeed hyoscyamine. In fact, in the presence of impurities, either in the process of preparation or in the bottles in which the substances are kept, or by the use of too great heat in the preparation, hyoscyamine is readily converted into atropine. Hence it is necessary to distinguish clearly between these two when they are purchased, before drawing conclusions from the results obtained.

Duboisine is obtained from *Duboisia myoporoides*. It is more energetic in its action than atropine. A drop of a 1-to-1,200,000 solution is sufficient to produce a distinguishable mydriasis, and a drop of a 1-to-3,000 solution produces a well-marked paralysis of accommodation. On account of its energetic action it is to be preferred to atropine in cases of inflammation of the iris or posterior synechia, where mydriasis is required.

Scopolamine, derived from *Scopolia japonica*, is one of the more recently discovered mydriatics. Its effects, like those of duboisine, are more rapid and lasting than those of atropine.

Cocaine, the invaluable local anæsthetic, is a decided mydriatic. A 1-to-200 solution will dilate the pupil almost as promptly as atropine, but this dilatation begins to subside after a few hours, and at the end of a day or two is hardly perceptible even by exact measurement. Cocaine is therefore of value when it is desired only to dilate the pupil in order to examine the interior of the globe. When its use is long continued or in strong solutions it has the disadvantage of producing an exfoliation of the epithelium of the cornea. On this account it is to be used with some caution, especially if strong solutions of sublimate are also being applied to the eye.

Gelsemine has been classed among the mydriatics, but it is of doubtful value, and **daturine** has also had a place assigned to it in this list, but probably this last is only one of the forms of atropine.

In the foregoing list the first three have been made to follow each other because they are to a certain extent related. It gives a better therapeutic view of all, however, to divide them

into two groups, namely: 1. Those that dilate the pupil, paralyzing the accommodation either not at all, or but for a short time. These are cocaine, homatropine, and hyoscyamine. 2. Those that are more active, affecting both the size of the pupil and the muscle of accommodation. They are atropine, duboisine, and scopolamine.

As to the manner in which mydriatics act, it has been ascertained by experiment that the solution passes through the tissues of the cornea, enters the anterior chamber, and there acts upon the iris. Indeed, if a strong solution of atropine is instilled into the eye of a rabbit, if the conjunctiva is then thoroughly cleansed from all traces of the original solution, and if the aqueous humour is extracted, a sufficient amount of the solution may be found in the aqueous humour to produce dilatation of the pupil of a second rabbit.

The effects of a mydriatic are, first, to dilate the pupil. When simple dilatation of the pupil is desired, for the purpose of examining the interior of the eye, weak solutions of atropine are very frequently employed. This, however, is a mistake, because the inconvenience resulting from the paralysis of accommodation which atropine also produces is unnecessary and troublesome. In homatropine we have a mydriatic whose action is quite as prompt as that of atropine, and whose effect is by no means so lasting. Still more convenient than this is cocaine, which also promptly dilates the pupil of the normal eye to such a degree that it is possible to make a thorough ophthalmoscopic examination.

The second action of mydriatics is to paralyze the ciliary muscle. This is of special use to the practitioner when he desires to measure the refractive condition of the eye. By this action of the mydriatic the near point is made to recede from the eye until it coincides with the far point, thus placing the accommodation entirely at rest. In regard to the choice of a mydriatic for this purpose, homatropine is the one usually selected. It is best to use quite a strong solution and apply it to the conjunctival sac a number of times in succession. The complete relaxation of accommodation which is produced does not last for a long time. This is a disadvantage, of course, to the practitioner, because he must always make use of the comparatively short time during which the effect is at its maximum to obtain the most reliable measurement; but, on the other hand, it is a great convenience to the patient to be rid of the annoyance which protracted paralysis of the accommodation produces. In a word, it may be said that, while much more inconvenient for the practitioner, it is much more convenient for the patient. If more marked and persistent paralysis of accommodation is desired, this is obtained readily by means of the stronger solutions of atropine and, of course, with duboisine or scopolamine.

[In the *New York Medical Journal* for March 24, 1894, Dr. D. B. St. John Roosa says that when he was in Paris, in 1887, he was greatly surprised to find that Javal, who had been an enthusiastic advocate of the use of atropine for a long time and who had been in the habit of prescribing glasses from the results obtained with the aid of atropine, now, since he had perfected the ophthalmometer, had entirely abandoned the practice.

Dr. Roosa deprecates the indiscriminate use of atropine—for example, in persons beyond forty years of age, where there can be no question of spasm of accommodation except in entirely extraordinary and exceptional cases.

"In a very large practice in refraction cases in the Manhattan Eye and Ear Hospital for the last three years," he says, "my staff and myself have not used a mydriatic, except in the most exceptional cases, for the purpose of testing patients for glasses. We have never had such satisfaction in our prescriptions, and we have relieved our patients of a great loss of time and ourselves of a great burden in work. . . . If the ophthalmometer is used, and the difference between the vertical and horizontal meridians of the cornea is once fairly established, the rest of the prescription becomes a matter of a very short time."]

The third purpose for which mydriatics are used is in the treatment of inflammations—sometimes those of the cornea, and especially of the iris or uveal tract. It is difficult to say in what way the mydriatic affects *corneal ulceration*, but, without any question, this does occur, probably by the change which takes place at the same time in the intra-ocular tension, the discussion of which would lead us too far from the present subject.

One of the very great advantages, however, of the mydriatics is their use in cases of *iritis*. In the normal eye the iris floats in the aqueous humour, almost or actually touching the anterior surface of the lens when the pupil is contracted, and draws away from it in a direction tangent to its surface. Now, in plastic iritis an exudate is often poured out in the anterior chamber attaching the posterior surface of the iris to the anterior capsule of the lens, either at one point or along its entire inner surface. This attachment of the iris to the lens capsule, known technically as posterior synechia, is one of the dangers to be guarded against in the treatment of iritis. In the mydriatics we have agents which, by dilating the pupil, will thus draw the iris away from any dangerous point. In this way not only does the pupil remain freer of obstruction, but when the exudation is subsequently absorbed the iris is again free to move without hindrance.

When a mydriatic is used on account of inflammation of the cornea or iris, of course those of weaker and more evanescent action are practically useless. For this purpose atropine is one of the most, if not the most, desirable. It is easily obtained, cheap, and reliable. When the question is asked as to how strong the solutions should be, or how frequently they should be employed, the answer is to be found in the action of the iris. They should be used often enough and strong enough to make the pupil dilate, unless the constitutional effect of the mydriatic as a poison begins to appear. When the cornea is infiltrated it is sometimes practically impossible to produce mydriasis.

Also, in cases where the tissue of the iris is swollen, and especially where it has been bound down to the capsule of the lens by exudations, it is difficult or impossible to dilate the pupil.

Having thus mentioned the principal mydriatics, and also shown the reasons for which they are used, I think it necessary to refer briefly to two conditions in which a certain amount of caution should be exercised. The first of these is in cases where there is a possible tendency to glaucoma. That disease, as we know, when in the acute stage is not infrequently mistaken for iritis. In both there is a certain amount of photophobia, ciliary injection, pain, change in the structure of the iris, and dimness of vision. But, on the one hand, in iritis we find the cornea sensitive and transparent, the vessels are bright red and almost straight, the anterior chamber is of normal depth, the pupil is rather small, the tension is normal, the optic disc is normal, and the field of vision is normal. On the other hand, in glaucoma we find the cornea dull and partly insensitive, the blood-vessels dark and tortuous, the anterior chamber shallow, the pupil usually dilated, the tension increased, the optic disc excavated, and the field of vision contracted.

These symptoms are stated in detail because of their great importance when a question arises as to the advisability of using a mydriatic of any kind, especially one of those which have quite a decided action, such as atropine, hyoscyamine, duboisine, and scopolamine. Wherever there is reasonable doubt as to the diagnosis, it is better to avoid the use of a mydriatic entirely until the nature of the disease is thoroughly ascertained, for every practitioner of experience has undoubtedly seen many instances in which a mydriatic has been carelessly prescribed for a person having glaucoma, and the acute attack has been increased in severity, with corresponding diminution of vision, sometimes to such a degree as to precipitate complete and permanent blindness. A few cases like that show the necessity of this caution.

Another danger to be mentioned, but one not so important as the first, is in the use of the stronger mydriatics by persons who have a constitutional idiosyncrasy in regard to them. While solutions of half of one per cent. of sulphate of atropine, for example, can ordinarily be used with impunity, every now and then an individual is met with in whom the instillation of even two or three drops of so weak a solution is sufficient to produce dryness of the throat, dizziness, nausea, and other symptoms exceedingly uncomfortable if not of a dangerous character. It is well, therefore, to ascertain the peculiarities of the individual, wherever this is practicable, before strong solutions are advised for long-continued use.

LUCIEN HOWE.

MYDRIN.—This is a German trade name for a mydriatic solution of ephedrine and homatropine.

MYOTICS.—See MEIOTICS.

MYRCIA.—Bay oil, *oleum myrciæ* (U. S. Ph.), a volatile oil distilled from the leaves of *Myrcia acris*, is the basis of *spiritus myrciæ* (U. S. Ph.), which is the official substitute for bay rum. It consists of 16 parts of bay oil and 1 part each of oil of orange peel and oil of pimenta, dissolved in 1,220 parts of alcohol, with the addition of enough water to make the solution measure 2,000 parts. Bay rum is a grateful addition to cooling lotions.

MYRISTICA.—See NUTMEG.

MYRONIN.—This is a German trade name for a mixture of fats put upon the market as a basis for ointments. It is described as slightly aromatic, of the consistence of butter, and proof against rancidity. Dr. J. Nemann (*Mntsh. f. prakt. Dermatol.*, xxi, 1895) says that it mixes readily with powders and with watery solutions to form ointments, but is too firm to be suitable for pastes. He has used it pure in cases of dry, scaling, superficial *eczema*, with apparent benefit in alleviating the itching and lessening the scaling. Myronin, according to Dr. Nemann, should not be used for making chrysarobin ointments, as it rapidly oxidizes the chrysarobin.

MYRRH, *myrrha* (U. S. Ph., Br. Ph., Ger. Ph.), is a gum resin obtained from the *Commiphora* (or *Balsamodendron*) *Myrrha*, a small stunted tree that grows in Arabia, in the East Indies, and on the northeastern coast of Africa. Myrrh is composed of a neutral resin, *myrrhin*, $C_{48}H_{32}O_{10}$, that becomes acid when it has been fused for a short time, and is called *myrrhic acid;* of arabin, a gum; of a volatile oil, $C_{10}H_{14}O$, *myrrhol*, or *myrrhenol;* of water; and of calcium and magnesium carbonate, ferric oxide, and calcium sulphate. It is partially soluble in water, in alcohol, and in ether, and forms an emulsion with the first mentioned. The dose of the powder is from 2 to 30 grains.

When applied locally, myrrh is somewhat *astringent* and *stimulating;* internally it is a *carminative* and an *expectorant* in small doses, but is likely to cause vomiting and purging in large doses.

Tincture of myrrh, *tinctura myrrhæ* (U. S. Ph., Br. Ph., Ger. Ph.), is used as a local application in *aphthous inflammations, spongy gums*, and *Riggs's disease*, and internally as a *tonic, expectorant*, and *emmenagogue*. The dose is from 10 to 30 minims. An unofficial tincture that once had considerable popularity under the names "hot drops" and "number six" was a tincture of myrrh and capsicum, made with 6 parts of myrrh and 3 of capsicum treated with 100 of alcohol; it was used as a carminative in doses of from 10 to 60 minims.

Myrrh has slight stimulating properties that have been considered to influence especially the lungs and the uterus. Locally, the tincture has been employed as a pleasant *mouth wash*, as an antiseptic and stimulant in *ptyalism*, as a gargle in *sore throat*, and as a stimulating application to *indolent ulcers*. Internally myrrh has been used as a tonic in *catarrhal gastritis*, in *gastralgia*, in *bronchorrhœa*, in *amenorrhœa*, and in *leucorrhœa*.

[Dr. Kahn, of Würzburg (cited in *Med. Annual*, 1894), has found a cerate of myrrh (strength not stated) very useful in *eczema of the nostrils* and in *atrophic rhinitis*, whether simple or fœtid. Pledgets of cotton impregnated with the cerate are passed into the nostril and allowed to remain for fifteen or twenty minutes.

Miloslawski (*Medicinskoe Obosrenije*, 1895, No. 15; *Deutsche Medizinal-Zeitung*, Jan. 27, 1896) has reported extraordinarily favourable results from the treatment of *diphtheria* with myrrh. From December, 1894, to Feb. 15, 1895, in a village of the government of Saratow, he says, forty-two cases of diphtheria were treated with tincture of myrrh; twelve of them were severe, twenty were of medium severity, and ten were light. The patients' ages ranged from one to twenty-three years, but the majority were between ten and fifteen years old. Three died; one of them was a year old and two of them were three years old. All the patients were under the physician's direct observation. The preparation given internally consisted of

Tincture of myrrh........	4 parts;
Glycerin..................	8 "
Distilled water...........	200 "

A teaspoonful of this mixture was given every hour to children under two years old, a dessertspoonful every hour to children from three to ten years old, and a tablespoonful every two hours to adults. In the case of children with whom the procedure was practicable, the pharynx was painted with tincture of myrrh four or five times, in addition: in that of adults gargling with the tincture was employed. Under this treatment the diphtheritic membrane began to be detached as early as on the second or third day, the temperature fell, and the general condition speedily improved. The average duration of the treatment was from six to eight days.]

SAMUEL T. ARMSTRONG.

MYRRHOLIN.—Dr. Kahn, of Würzburg (*Med. Annual*, 1894), employs under this name a solution of myrrh in an equal quantity of oil, together with creosote, in *laryngeal* and *pulmonary phthisis*. He finds that the myrrholin enables patients to bear the creosote far better than when the latter is given alone. He is not, however, as yet, able to say whether the myrrholin exerts any direct action on the disease. He prescribes a mixture of 4½ grains of creosote with 3 grains of myrrholin for a dose, to be taken in capsules.

MYRTOL.—This is a volatile oil distilled from the leaves of the myrtle, *Myrtus communis*. Locally, it acts as an *antiseptic;* given internally, it has been thought to exert a remedial action in *weak digestion*, *defective appetite*, and the chronic forms of *bronchitis* and other *chronic catarrhs*. It may be given in 5-grain doses, in capsules, to the amount of 15 grains a day.

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